THE

ELECTRICAL REVIEW.

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CONTENTS:

	PAGE
Refuse Destruction	293
Electric Motor-Cab Service in New York City (*illustrated*) ...	295
The Donaldson Compound Gas Engine (*illustrated*)	298
The Westinghouse Gas Engine (*illustrated*)	299
Reviews:—The Alternating Current Circuit	300
Machine Shop Arithmetic	300
British Association for the Advancement of Science:—	
A New Method of Investigating the Variation of the Magnetic Qualities of Iron with Temperature	300
On a New Method of Measuring Hysteresis in Iron ...	301
On a New Method of Determining the Specific Heat of a Liquid in Terms of the International Electrical Units ...	301
Screw Gauge	302
On a Research in Thermo-Electricity by Means of a Platinum Resistance Pyrometer	302
The Engineers' Dispute	303
The Telegraphists	304
The Liverpool Tramways	305
The British Association	305
Correspondence:—Leeds Tramways and American Practice ...	306
Cable Testing.—The Rapid Cable	306
Willard Storage Battery Launches	307
The Postal Telegraphists	307
The Economic Boiler	308
The Telegraphs of United Kingdom	308
Business Notices, &c.	309
Electric Lighting Notes	310
Electric Traction and Motive Power Notes	311
Telegraph and Telephone Notes	312
Contracts Open and Closed	312
Notes	313
City Notes	316
Traffic Receipts	316
Share List of Electrical Companies	317
Electric Plant Run by Wind	318
The Electric Plant of Modern Tall Buildings	319
Accumulators: their Application to Central Station Lighting and Power	319
Electricity in the Modern Machine Shop	320
Do we know How to Pack Machinery?	321
The Economy of the Modern Engine Room	321
The Predetermination of the Regulation of a Transformer with Non-inductive Load (*illustrated*) (*concluded*)	322
New Patents and Abstracts of Published Specifications ...	324

NOTICE OF REMOVAL.

THE "ELECTRICAL REVIEW."

THE "UNIVERSAL ELECTRICAL DIRECTORY."

On and after September 6th, the Offices of the above Publications will be removed to

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PROPRIETORS.

REFUSE DESTRUCTION.

IN the *Scientific American* of August 14th appears an interesting article entitled "The Utilisation of New York City Garbage," which illustrates the difference between the treatment accorded to city refuse in the Old World and the New.

In the States the idea of utilisation is in many instances paramount, and so far destruction or cremation is run very hard by the process of reduction or "rendering," as it is sometimes called. Such a rivalry of the destructor is only possible where, as in the States, the refuse to be dealt with is rich in grease and fertilising matter. The city refuse of the States appears to be generally of a very different composition from the refuse of English towns, owing partly to the climate and the nature of the food, and partly to the habits of the people and methods of collection that prevail.

The refuse, when collected all together, has been described as more resembling "pig swill" than English town muck, being of a semi-liquid consistency. It has, in fact, to be collected in water-tight carts. This shows that a great deal of greasy slop water which, with us, goes down the drains, in the States goes into the refuse bucket.

This is one very important difference between the waste products of the Old World and the New; but a further and still more striking difference appears in the method of collection.

In New York, according to the article above referred to, the docile householders and managers of hotels and industrial concerns are required to classify their refuse into three separate divisions: (1) ashes, (2) garbage, (3) light refuse, and place it in readiness for removal in three separate receptacles.

That such an arrangement is possible, shows how well drilled in sanitary matters must be the Yankee occupier.

It is not long since it was proposed to classify the refuse in the houses of Berlin in a much more simple manner, but the idea was declared impossible of realisation.

In Berlin, the great difficulty in dealing with the refuse arises from the enormous proportion of absolutely incombustible fine ash from the closed slow combustion German stoves universally employed in the houses. Now, if every householder used two receptacles and were compelled to put the stove ashes in one, and all the miscellaneous rubbish and refuse in the other, it would be comparatively easy to deal with both. The putrescible matter would burn very freely when separated from the stove ashes, while the stove ashes, being absolutely non-putrescible, could be tipped away at comparatively small cost. To separate them by sifting after collection is not advisable, as the ashes would then have been in contact with the vegetable stuff, and organic matter would become mixed with them.

To separate them in the houses as proposed was said to be impracticable, owing to the difficulty of controlling householders and their servants. But this is precisely what is done in Toronto, where the stove ashes are collected separately, and the organic rubbish is burned in destructors;

and, as it now appears in New York, householders and other occupiers are forced to classify their refuse into the three divisions above mentioned. Ashes, broken crockery, oyster and clam shells, are in the first division, and the method of handling the material was described previously by our esteemed contemporary on June 5th last.

Steam dumping scows are at present employed to remove the stuff to the outside dumping ground, but ultimately they will undertake the reclamation of swampy ground at Riker's Island.

The second class of refuse, viz., garbage, is the subject of the present discussion, and we may look forward to a future description of the method of dealing with the third division, consisting of light refuse, such as paper, rags, and so forth.

The company on Barren Island receives about 800 tons of garbage per day, which is brought alongside in scows, from which it is removed by means of a powerful conveyor to the top of the building in which the rendering machinery is housed.

It is first passed into large vertical "digesters," of which there are 48, 5½ feet diameter, and 18 feet long, where it is subjected to the action of steam at 50 lbs. pressure for eight to 10 hours. It is thus thoroughly disinfected and reduced to a pulp. It is then dropped into storage tanks, and from thence conveyed to a series of ponderous screw-down filter presses, where it is subjected to a total pressure of 250 tons (area of press is not stated), and reduced from a thickness of 4 feet to 18 inches. The cake is afterwards dried in mechanical driers, screened and turned out as a *poudrette* fertiliser, containing 4½ per cent. ammonia, 14 per cent. phosphate, and 0·3 per cent. of potash. It appears that this fertiliser is sold for further enrichment in a manure works before being placed upon the market.

The grease and water from the presses is settled in large tanks, the grease being recovered by skimming, and immediately "barrelled" for shipment to the soap works.

From the water is further extracted 14 per cent. of soluble ammonia and 1½ per cent. of soluble potash.

We are told that the commercial value of the city refuse is more than sufficient to pay for the cost of its collection. We could have wished our contemporary had been more explicit upon this point. Does the City of New York receive anything from the Utilisation Company, and if so, how much per ton? Or does it, on the contrary, pay something to be rid of the most objectionable part of its refuse? The question of destruction or utilisation in all cities is mainly one of £ s. d., though its sanitary aspect must not be neglected. That our good cousins are not quite satisfied upon the point is evidenced by the present efforts of the American Public Health Association, who have appointed an influential committee to enquire into the subject of destructors.

Only an interim report has yet appeared, but we should not be surprised if the exhaustive investigation which this body are conducting into European methods of refuse disposal were to result in a change of policy in favour of destruction.

In support of this we will quote only the following sentences from the report, which is from the pen of Mr. Rudolph Hering, C.E.:—

"Probably the best reduction plant to-day is that situated on Barren Island, where the garbage of New York and Brooklyn is being treated by boiling, the grease being subsequently extracted by pressure.

"Whether this plant can be profitably operated for the contract term of 5 years without causing a nuisance, remains to be seen.

"The cost of the reduction process has varied considerably in the different cities. The returns show a variation of from 10 cents to 67 cents per capita, excluding the cost of the disposal of dry refuse."

It is well known that many of the "rendering plants" in American cities have been productive of serious nuisance, and what is, perhaps, more to the point, of serious loss to their promoters; while, from a sanitary point of view, it is well known that doctors prefer to burn up "everything," so as to make sure work of the bacteria.

Then arises the question of power from the destructor, and if it can be shown, as we believe it has been shown on a limited scale at Oldham (see our issue of October 23rd, 1896), that, after all, steam is the most valuable bye-product resulting from the disposal of refuse—at least, in this country—then the able description in our contemporary of an excellent example of American enterprise and skill will remain, so far as we on this side are concerned, merely an interesting piece of engineering history.

The Motor-car in the States.

We abstract elsewhere in this issue an article from a New York exchange on the electrical cabs now in operation in New York city, and this following the advent of similar vehicles in London will be read with interest. We all know to what an extent animal power for the propulsion of street cars in the States has been superseded by electro-mechanical power, and every electrical man on this side waits with more or less impatience for the time when electrical tramways shall be quite common here as they are across the Atlantic. But although America has done so much in electric traction on tramways she is little ahead of us in electrical carriages and wagons. Not much has been accomplished either here or there, but the little that has been done threatens the horse, as the *Electrical World* remarks in a leaderette, with further degradation by the substitution of like mechanical power in this class of vehicles also. But at the present rate of progress it will be some years ere the horse will be affected to any large extent on this side. One fact in connection with the recent inauguration of electrical cabs in New York is particularly interesting, viz., the service is placed on a firmer foundation at its initiation than was the electric tramway industry some 10 or 15 years ago, when, as many of our readers will remember, millions of dollars were recklessly spent upon lines which ought never to have been laid down, and whose plant was soon consigned to the scrap heap. Our contemporary remarks that the New York travelling public has not been compelled to suffer any inconveniences attributable to faulty construction and general untrustworthiness of these vehicles, but has had, from the first, placed at its disposal electric carriages finished as to design and construction, and reliable as to mobility. "In other words, all experimenting has been done at the factory, in private, and what the public is familiar with is the comparatively perfect machine. The wisdom of this course of development, from a commercial point of view, is evident from the liberal manner in which the public patronises the enterprise." Whatever may be the reliability or the beauty of design and finish, we have to come back to the economic consideration, and the questions put by our New York friends, "Does it pay, or will it be likely to pay in the future?" will have to be answered in this country by the results of daily practice before we can expect any extensive revolution in the method of vehicular propulsion. But this is a matter which we feel will be carefully watched by the electric cab companies of London and New York respectively, for they will best serve their own ends by producing trustworthy figures of daily operation, which will show without any further doubt whether the cost of electrical propulsion compares favourably with horse haulage.

ELECTRIC MOTOR-CAB SERVICE IN NEW YORK CITY.*

Mechanically-Propelled Vehicles.

No modern development is fraught with greater possibilities than the motor-propelled road vehicle. We have arrived at an age in which mechanical power reigns supreme. For economical, humane, sanitary and other reasons, it must eventually take the place of animal energy for all purposes. In the development of our present methods of transportation over fixed roads, the horse has been almost universally relegated to the past, and, beyond all doubt, the time when the same can be said of all other wheeled conveyances is a possibility within the life of many who, 10 years ago, doubted the ultimate success of the present overhead trolley electric street railway.

The present practically universal application of the electric motor to street railway traction purposes has almost eradicated the fact that but a few years ago many rivals were in the field. To-day a problem of equal, if not greater, importance is the substitution of mechanical for animal energy for the propulsion of common road vehicles. Although by no means a new problem, it is only within recent years that it has obtained particular prominence and attracted universal attention. Many claimants for success have appeared, and some have unquestionably indicated excellent future possibilities. European productions in this direction have rather favoured vapour and steam-motor propelled vehicles. In this country, it may well be said that electrically-propelled motor road vehicles have attained marked prominence and success. Although steam and gas motors have peculiar advantages as portable motor powers for this purpose, the fact remains that none of these can compete with the simplicity, flexibility, safety, freedom from disagreeable features, ease of application and control, and many other excellent features of the electric motor. It is true that the electric motor propelled vehicle has failings, but these are entirely due to the present form of electric current supply from lead storage batteries. This latter element probably limits the application of the electric vehicle to certain classes of work. When, however, long travelling capacity is a secondary consideration, it can now be authentically asserted that the electric vehicle surpasses the results obtained with vehicles propelled by either steam or gas, both of which may have their particular field until such time as the difficulties inherent in the present portable current-supplying appliances are eliminated.

With the earliest development of the storage battery, electric-motor vehicles made their appearance. Among the pioneers in the development of such conveyances were Messrs. Morris & Salom, who almost 10 years ago first experimented in this direction. The result of their work did not, however, take any prominent shape until about two years ago, when the Morris & Salom "Electro-bat" was entered in the Chicago *Times-Herald* motor-vehicle race, and was awarded first prize for superior features, although it did not even go over the entire course.

This vehicle resembles a surrey in general appearance. It is still in use, and forms part of the equipment to be described. The development of the ideas embodied in this conveyance resulted in the formation of the Electric Carriage and Wagon Company, which has inaugurated in New York city an electro-motor cab and carriage service. A variety of other electrically-propelled conveyances have also been built, all of which, however, embody, more or less, the same general mechanical and electrical features. Stations in other cities are also to be established.

This motor-cab service and station has now been in actual service for some five months, and although no attempt is made to compete in rates with other cab service, yet the demand for electric-motor cabs has assured the success of the enterprise. This pioneer electric cab station is said to be already on a paying basis. The New York station is in charge of Mr. C. J. Harrington, to whose energy and enterprise the success of the venture is largely due.

The Station.

Several doors west of Broadway, on Thirty-ninth Street, the station of this pioneer electric-motor cab service is located. The building utilised for this purpose is a three-story brick structure occupying a ground space of about 40 × 100 feet. On the ground floor are the rental office, storage-battery racks, switchboard and charging apparatus, and the cab equipment. The cabs are all placed side by side, and the batteries on the other side of the room. That section occupied by the cabs has an inclined cement floor with suitable sewer drains, so that the vehicles can be easily washed and cleaned. On the right, in front of the cabs, at the entrance to the building, is the rental office. In the rear is the switchboard room, immediately behind the battery racks.

The second floor is used as the repair department, being equipped with lead-burning furnace, electric tire pump, and suitable tools for battery, motor, and vehicle repair. A section of this floor is partitioned off and used as a main office. Ample storage facilities are afforded on the top floor. This station is open at all hours. Its location could not be better for the purpose, as it is almost in the centre of New York's busiest district.

The Vehicles.

Twelve electric hansom cabs and the surrey previously mentioned constitute the rolling-stock equipment of this station. Aside from these, however, the Electric Carriage and Wagon Company has completed and is developing other types, among which are broughams, victorias, coaches, delivery wagons, &c. In fact, the equipment in this city is to be increased by the addition of a very handsome electric brougham, which will be manned by a liveried coachman and footman, and will no doubt create quite a stir on the streets of New York. In the construction of these vehicles two general plans have been adopted. In the construction of the surreys and the hansom the design of the body is modified to accommodate the batteries, while in the case of the brougham, delivery wagons, carriages, &c., the entire mechanical and electrical equipment is independent of the body proper, which can be constructed precisely as the present designs.

Certain essential elements and limiting conditions were clearly demonstrated in the earlier experiments made by Messrs. Morris & Salom, and these were closely followed in the construction of the present vehicles. Briefly, these may be stated as—Maximum total weight of vehicle; maximum total weight of battery; maximum distance and maximum speed.

It has been shown that a variation of any one of these elements will necessitate a change in the others. The best results obtained with these vehicles show that about 1·25 horse-power is necessary for the propulsion of 2,000 lbs. over ordinary approximately level roads at 10 miles per hour. This consumption of energy, which is only two and a third times that necessary for similar work on rails, is astonishingly small, and can only be obtained by the reduction of all mechanical losses to a minimum, the use of an excellent motor and transmission, and a battery of only sufficient size to afford a practical travelling capacity, thereby bringing the weight within a reasonable limit.

Careful deduction and the result of experiments and trials have enabled the designers to approximately state as follows the limiting figures of the four elements above-mentioned:—

Maximum total weight of vehicle.	Max. weight of battery.	Max. distance. Miles.	Max. speed.	Average speed.
Surreys, 2,000 lbs. ...	800	35	15	8
Hansoms, 3,000 lbs. ...	1,200	25	12	6
Broughams, 3,300 lbs. ...	1,200	25	12	6
Closed carriages, 3,500 lbs.	1,200	25	10	6
Victorias, 2,000 lbs. ...	800	35	15	8
Landaus, 2,500 lbs. ...	1,200	25	12	6
Delivery wagons, 3,000 lbs.	1,200	25	9	6
'Buses, 5,000 lbs.	...	...	...	...

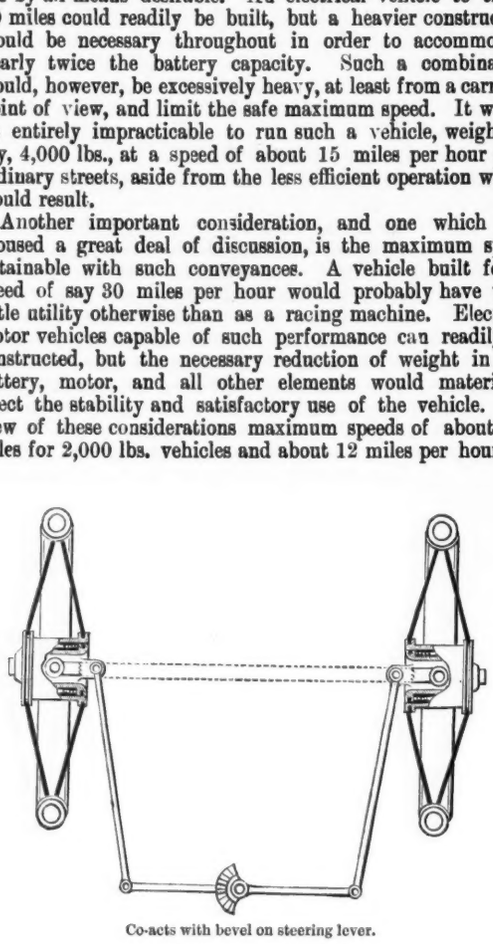
To propel a vehicle weighing about 2,000 lbs. with passengers, at a speed of 10 miles per hour it would be necessary to have a battery output of somewhat over 1½ horse-power. The essential output would, however, be far exceeded ordinarily, and approach nearer 3 horse-power. It has therefore been found that about 900 lbs. of battery are needed to give a travelling capacity of about 30 miles at this rate, or about 1,350 lbs. with a vehicle weighing complete about 3,000 lbs.

* New York *Electrical World*.

It has been urged that the practical electrical vehicle has a very limited travelling capacity. Close investigation will clearly demonstrate the fact that the average carriage or wagon horse does not travel more than 25 to 30 miles per day. It is not expected that a trip from New York to Philadelphia, for instance, should be made with one horse relay; in fact, it would be more in keeping with usual methods to make such a trip by rail. It does not seem essential, therefore, to provide a motor vehicle with any such excessive travelling capacity; but if there should be occasion to do so, the eventful substitution of the electric motor carriage charging station for the livery stable will make this a possibility.

Greater maximum travelling capacities than above stated are by all means desirable. An electrical vehicle to travel 50 miles could readily be built, but a heavier construction would be necessary throughout in order to accommodate nearly twice the battery capacity. Such a combination would, however, be excessively heavy, at least from a carriage point of view, and limit the safe maximum speed. It would be entirely impracticable to run such a vehicle, weighing, say, 4,000 lbs., at a speed of about 15 miles per hour over ordinary streets, aside from the less efficient operation which would result.

Another important consideration, and one which has aroused a great deal of discussion, is the maximum speed obtainable with such conveyances. A vehicle built for a speed of say 30 miles per hour would probably have very little utility otherwise than as a racing machine. Electric-motor vehicles capable of such performance can readily be constructed, but the necessary reduction of weight in the battery, motor, and all other elements would materially affect the stability and satisfactory use of the vehicle. In view of these considerations maximum speeds of about 15 miles for 2,000 lbs. vehicles and about 12 miles per hour for

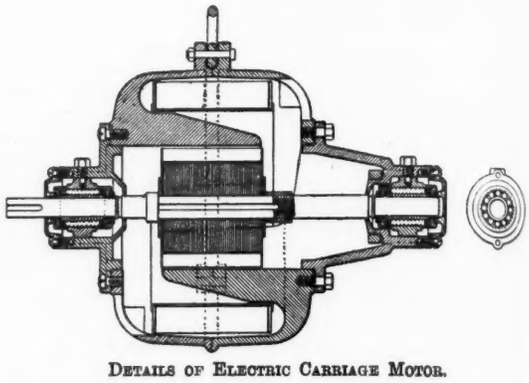


Co-acts with bevel on steering lever.

Details of Steering Gear.

heavier vehicles have been adopted in these electric conveyances.

All the various vehicles constructed by this concern are built on very nearly the same general lines. A detailed description of the electric hansoms will therefore serve to illustrate the general features of all designs. In general appearance the electric hansom carries out the lines of this type of vehicle as far as the fore body is concerned. The similarity ends here, however, as the vehicle essentially has four wheels and a rearwardly extending box body carrying the batteries and on which the driver's seat is mounted. In finish the cab body is elegant. The enamelling, trimmings, and upholstering are of the finest. The carriage proper is built by the Chas. S. Caffrey Company. Double doors are fitted to the fore body and are operated by means of a lever in front of the driver's seat. The vehicle has a very low centre of gravity, and the front and rear wheels are independently fixed to the vehicle body, the front being used for driving and the rear wheels for steering purposes. All the wheels are of a tangent-spoked metallic bicycle-type construction, with heavy 3-inch Hartford pneumatic tyres. The latter are inflated to about 100 lbs. pressure, giving a flat bearing on the pavement of from 6 to 8 inches. The front driving wheels are 44 inches and the rear wheels 32 inches in diameter. On some of the other vehicles wheels up to 42 inches in diameter, and tyres 5 inches in diameter, are used.

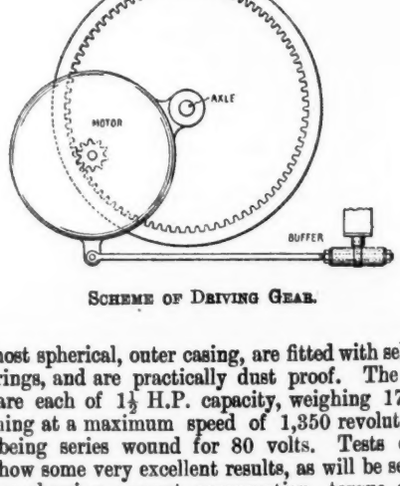


Details of Electric Carriage Motor.

It is to be especially noted that not only have front driving wheels been adopted in these vehicles, but each driving wheel is independently connected to a separate electric motor. It is claimed that several advantages result from the use of rear steering wheels. Unless the weight were properly disposed, however, this arrangement would by no means be desirable. Two-thirds of the hansom and passenger weight is said to be supported on the front wheels. The adoption of two independent driving motors eliminates the use of balance gears, which would be essential otherwise.

The Motors.

In the selection of a motor for these vehicles, many elements needed careful consideration, in order to secure a motor which should be highly efficient, almost absolutely weather, dust and water proof, and capable of developing for short intervals 200 to 300 times its rated normal capacity without developing any defects or weaknesses. A special type of bipolar, single-field coil Lundell motor has been adopted for all these vehicles. These motors have an iron-



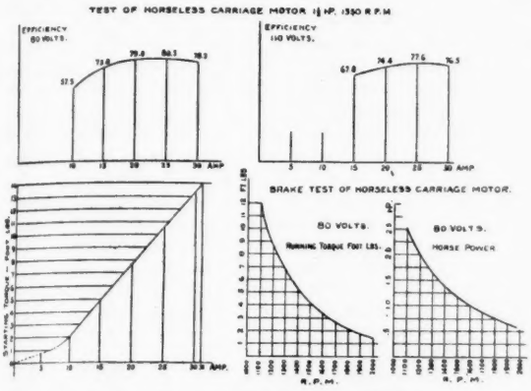
Scheme of Driving Gear.

clad, almost spherical, outer casing, are fitted with self-oiling, ball bearings, and are practically dust proof. The hansom motors are each of 1½ H.P. capacity, weighing 172·5 lbs., and running at a maximum speed of 1,350 revolutions per minute, being series wound for 80 volts. Tests of these motors show some very excellent results, as will be seen from the curves showing current consumption, torque and efficiency.

Two such 1½-H.P. motors have been found amply sufficient for these hansom cabs, which weigh, complete with passengers, 3,000 lbs. Such motors will, without any signs of undue heating or weakness, drive the vehicle at a maximum speed of 15 miles per hour, or develop an average vehicle speed of 8 miles per hour for 25 miles. For larger vehicles, up to 3,500 lbs., two 2-H.P. motors are used. These motors are wound for 75 volts at about 800 revolutions per minute.

The method of gearing the motors to each driving wheel is very simple. The driving wheels rotate on roller bearings at each end of a fixed axle. The gear consists of two internal

gears bolted to spun plates of steel, attached to the hubs of the front or driving wheels. The exterior of these internal gears may either form a surface to which the brake is directly applied, or through the medium of a supplemental band furnishing a removable wearing surface, the brake being applied

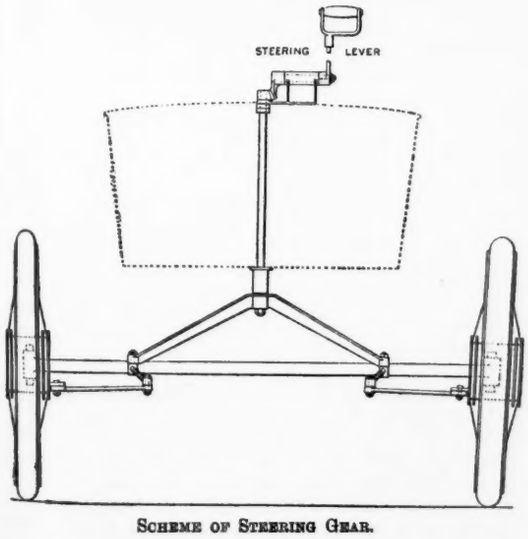


Curves Showing Operation of Motors.

by a foot lever in the usual manner. The pinions on the motor shafts engage directly with the internal gear, thus making a single reduction of suitable proportion between the motors and driving wheels of the simplest possible form.

Each of the driving motors is pivotally suspended from the fixed axle supporting the driving wheels. Fixed to the upper part of the spherical motor arm are two circular clamps holding the motor to the axle, and permitting it to swing radially on the axle, so that the motor pinion always remains in mesh with the gear on the wheel. Attached to the lower edge of the motor frame is a rod, the other end of which is fitted with a rubber buffer, which is fixed to the lower carriage body. This arrangement takes up all slight movements of the motor, and minimises shocks to the gearing, due to vibrations when travelling over rough roads. Both the driving and steering wheels are, so to say, independent of each other, each set being fitted to a separate supporting gear, on which each end of the carriage body proper is supported.

The arrangement, which is almost similar in each case, consists of two parallel, slightly bent compound flat springs placed horizontally across the vehicle at a slight distance

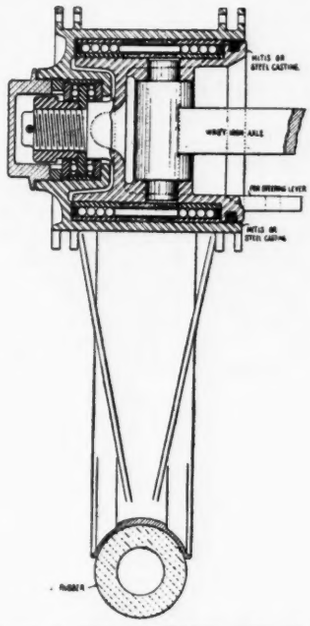


Scheme of Steering Gear.

from each other. These are fastened to suitable bolsters at the bottom of the vehicle body. Connecting the ends of these traverse horizontal springs are short connected springs pivotally attached to each end of the horizontal springs, and centrally fitted to these short connecting springs the fixed axles. Each cab is equipped with a cyclometer, registering the miles travelled.

Steering and Brake Gear.

A particularly interesting feature of the vehicles is the steering gear, which is what may be called the hub-pivoted type. At each end of the fixed rear axle is a T-shaped double vertical pivot, on which swivels a bearing shell to one side of which is fitted an inwardly projected arm. An examination of the illustration showing this arrangement in detail, will also indicate the method of taking up side thrusts. It will be noticed that the outside of each steering wheel proper is provided with an inwardly projecting flange. The previously-mentioned shell has an outwardly projecting screw lug, fitted with suitable discs, between which and the previously-mentioned wheel-hub flange are steel balls, arranged



Detail of Steering Wheel Hub Pivot.

so that the thrust pressure in either direction is taken up on them. An important feature in this construction is the accessibility to all parts, and the ease with which the entire steering wheel and gear can be inspected.

Attached to the previously-mentioned inwardly projecting arm from the pivoted-bearing shell is a pivoted rod connecting each of the steering wheels with opposite ends of a central-pivoted bar under the vehicle body, at about the centre. The pivot of this arm passes up in the form of a post until it reaches the top of the battery-carrying box body, where a bevel-gear segment is fitted to it. This bevel-gear segment meshes with another similar gear attached to the short end of the pivoted steering lever, the other end of which projects upward immediately in front of the driver's seat, and terminates in a spade handle. The movement of this steering handle forward or backward from its normal position operates the gear mechanism correspondingly. The wheels are turned parallel with each other. Although at first sight it might be supposed that steering from the rear would be more difficult than steering from the front, and notwithstanding the consensus of opinion among carriage men was decidedly opposed to rear steering, yet as a matter of fact this has not been found to be the case, as the carriages can be moved with the slightest effort on the part of the driver, and with the greatest certainty in any direction desired, and be turned completely around in a circle of from 20 to 30 feet in diameter, depending on the length of the wheel base, gauge, &c.

A peculiar form of brake mechanism has been adopted, in which simplicity and positive action have been particularly aimed at. Instead of using a separate brake mechanism, it was decided that the best place for the brake was directly upon the wheel tyre. Ordinarily, this plan would have been

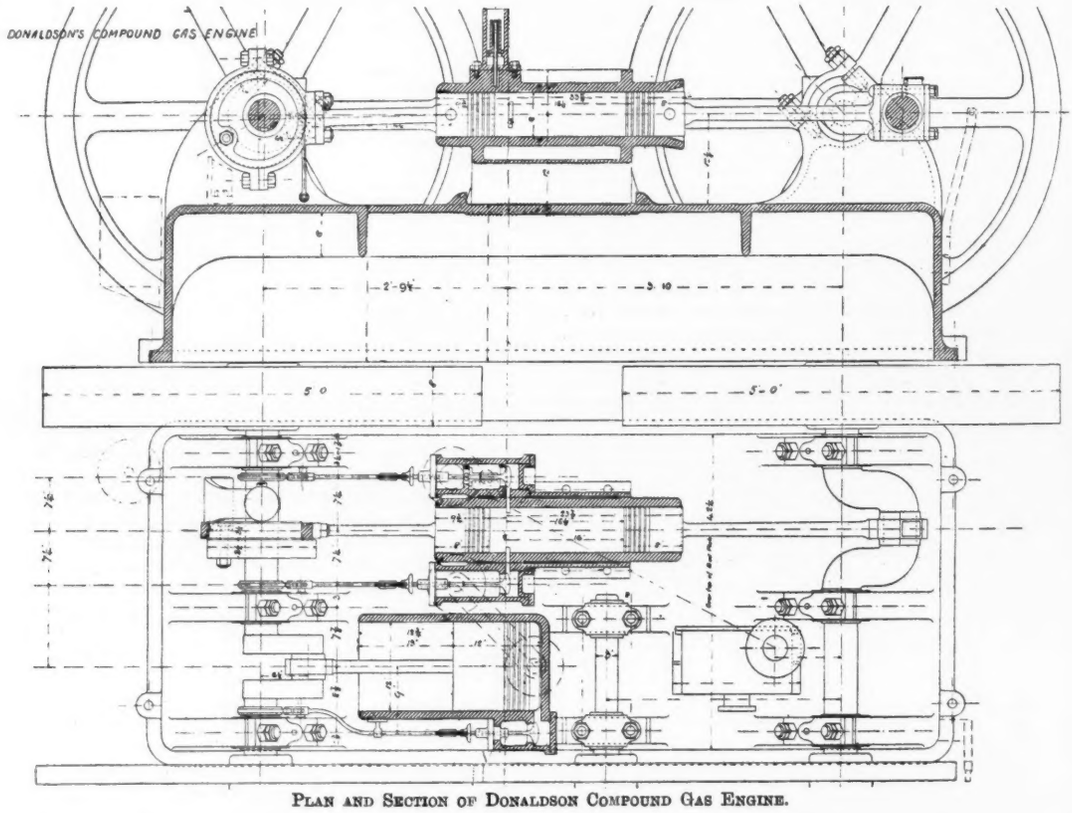
extremely unwise, owing to the possibility of serious wear upon the rubber wheel tyre. By the use, however, of a peculiar rolling brake shoe the wear has been reduced to a minimum. These brake shoes consist of two concave rubber rollers fitted to opposite ends of a short metallic support bar, which is fitted to one end of a pivoted lever, the other end of which is suitably connected with the foot-brake operating lever, immediately on the top of the battery-carrying portion of the body, and in front of the driver's seat. One of these brake shoes is arranged to act upon the rear of each driving wheel, and the levers to which each is attached come together about centrally between the wheels, where they are connected to the above-mentioned foot-operating device. An application of this brake shoe with almost any pressure possible through the foot-operating device does not cause a rubbing of the wheel tyre, as would be the case with an ordinary fixed brake shoe.

THE DONALDSON COMPOUND GAS ENGINE.

It is universally acknowledged that the products of combustion in a gas engine should be swept out as nearly as possible before the fresh charge enters the cylinder, and that a succession of explosions takes place during the working stroke. Some engineers think that part of the gas escapes without being exploded. In existing gas engines in which the exhaust gas is expelled by the pistons, the volume occupied by the exhaust gas at the end of the exhaust stroke cannot be less than the volume occupied by the compressed gases. In practice it varies from about one-third to one-fifth of the uncompressed volume of the charge. In order to insure a maximum efficiency, it is necessary to practically expel all the products of combustion and to produce instantaneous explosion; both these objects are said to be achieved by the methods patented by Mr. William Donaldson.

The Donaldson engine works on the Otto cycle. The explosion cylinder has open ends and is provided with two pistons, an operative piston and a regulating piston with a very short stroke. The crank shafts attached to the two pistons are so connected that the operative crank shaft revolves at double the speed of the regulating crank shaft. If the cranks are so set that the two pistons meet isochronously at the end of the exhaust stroke, the whole of the gases produced by combustion will be swept out except the volume contained in the port passages and the clearance between the pistons which need not exceed $\frac{1}{8}$th of an inch. It is preferable to make the regulating piston lag behind the operative piston. In this case a plate has to be added to the end of one of the pistons of a thickness equal to the linear lag of the distributing piston. If the pistons meet isochronously the regulating piston moves away from the operative piston during both the filling and compressing strokes, if the regulating piston lags behind during part of the filling and the whole of the compressing stroke, and in this way space is provided for the compressed gases. Instantaneous explosion is secured by effecting a thorough mixture of the gases before they enter the cylinder by means of a special mixing chamber, and by securing the admission of the right quantity of gas at each instant of the filling stroke by a method protected by a second patent. In most existing gas engines the mixing takes place entirely after the gas and air have entered the cylinder. The mixing chamber is separated by two mushroom valves, the one next the chamber having a rubber seat, so that an explosion in the chamber is impossible. The small space between the two valves is provided with a safety valve, so that an explosion there would be harmless.

When two explosive and one expansion cylinder are used, they are all attached to the same crank shaft, where there is only one explosive cylinder, the expansion cylinder is attached to the regulating shaft. The patentee has completed the working drawings of a two-cylinder engine, the diameter of explosive cylinder being 6 inches, the length of the operative stroke 16, and of the regulating stroke four inches. With a three-cylinder engine of this size it is claimed that the volume of the gases of combustion left in the cylinder would be less than $\frac{1}{18}$th of the volume of the uncompressed charge, with two cylinders only rather more than $\frac{1}{14}$th, because the gases at the termination of the exhaust stroke would be subject to about 40 lbs. pressure. By a very simple adjustment of the angle of lag the effect of using four different initial pressures varying from about 70 lbs. to about 220 lbs. can be tested. It has been stated by Mr. Dugald Clerk,

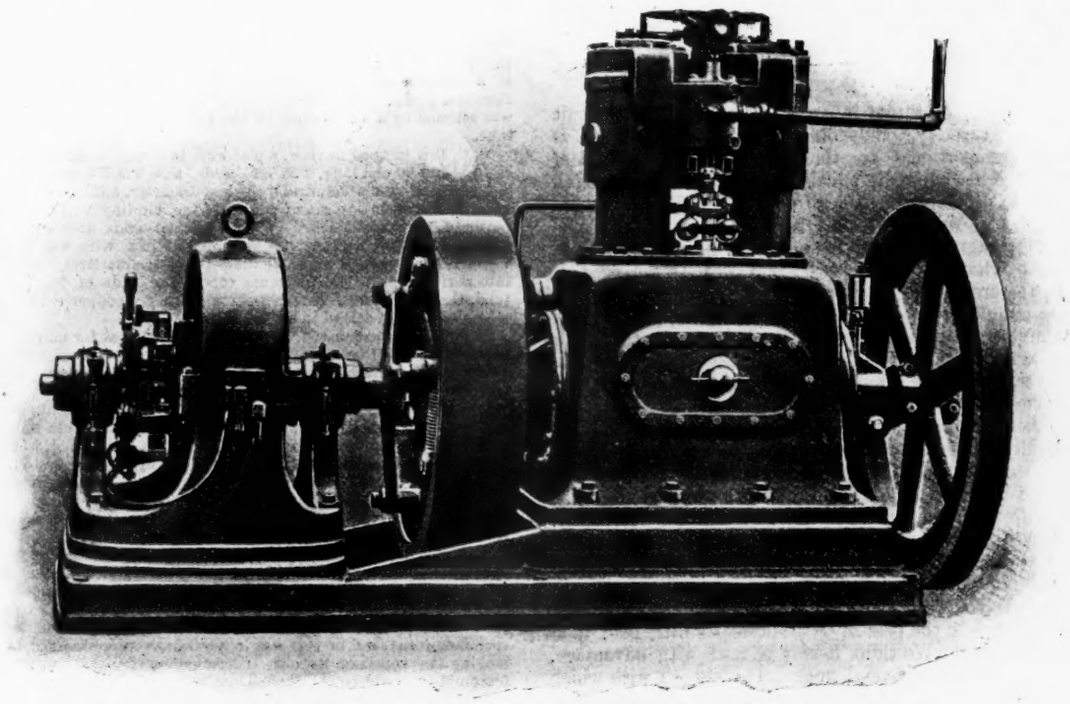


Plan and Section of Donaldson Compound Gas Engine.

that the initial pressure should be about 100 lbs., and that with 200 lbs. initial pressure combined with a clean sweep out of the exhaust gases, we ought to get over 600 lbs. explosive pressure. With instantaneous explosion, Mr. Donaldson expects to obtain 1,000 lbs. explosive pressure, possibly with 100 lbs. initial pressure. The maximum pressure hitherto attained appears to be less than 400 lbs. With the best efficiency hitherto claimed, the two-cylinder engine would give out 15 I.H.P. For reasons stated, the patentee thinks that the two cylinder engine will give out 30 I.H.P. and the three-cylinder 60 I.H.P.

THE WESTINGHOUSE GAS ENGINE.*

The Westinghouse Machine Company, of Pittsburgh, have just placed upon the market the Westinghouse gas engine, which they are prepared to furnish in all sizes from 5 horse-power to 500 horse-power. As will be seen from the accompanying illustration, the new gas engine is similar in



some respects to the well known Westinghouse steam engine. The gas engines have been put through thorough tests and trials before placing them on the market, and the manufacturers state that the apparatus they now offer is equal in perfection to the Westinghouse steam engine. For this line of gas engines the manufacturers have established a commercial rating which bears about the same relation to the ultimate brake horse-power as the rated capacity of the steam engine bears to its ultimate capacity; that is, the rating represents from 80 to 85 per cent. of the total maximum brake horse-power developed on the test.

In the smaller sizes of the Westinghouse gas engines there are two cylinders, and in the larger sizes three, cast of a special mixture of hard, fine grained iron, bored and finished with the highest degree of accuracy. The pistons are of the trunk pattern, backed with cast-iron spring rings, and carrying a case-hardened steel wrist-pin accurately ground to size, with which the upper end of the connecting rod engages. The connecting rods are forged from steel, and the adjustment of the piston end has been provided for in a very convenient manner. The shaft is made from the best quality of steel, the cranks being forged solid, and slotted out. The bearings are all adjustable, the lower halves being set up by wedges operated by screws. This insures the proper alignment of the shaft after each adjustment, and where the engine is direct connected to a dynamo, this feature is especially desirable, as it preserves the height, from the base of the engine to the centre of the shaft, as a constant.

The explosive mixture used in this gas engine is ignited by means of an electric spark. The igniters are simple in construction, durable, and mounted in small castings, easily removed and replaced. In sizes from 15 horse-power upwards there are double igniters in each cylinder. One of these is in operation and the other is held in reserve. In case of accident to the igniter in service, the battery wire can be instantly shifted to the binding post of the reserve igniter and the engine may be kept in service until it can be examined. The lubrication is of the regular Westinghouse order, effecting great economy in the use of oil.

Small gas engines are easily set in operation by giving the fly-wheel several turns by hand until the charge of gas and air has been drawn in, compressed and exploded. With the Westinghouse engines too large to be readily started by hand, a simple and effective air compressor and an air storage tank of ample capacity are supplied. An ingenious arrangement in connection with this compressed air apparatus converts one cylinder of the gas engine into a compressed air motor, without disturbing the functions of the other cylinder or cylinders, by which means the engine starts up and continues to run on an air pressure until explosion takes place in the other cylinder. This process is strictly automatic. The methods of regulation are of the most approved and modern type, and the makers state that for smooth running and steady speed, the Westinghouse gas engine is equalled only by the best steam engines. These engines are built to run on gas of any kind or quality, or on gasoline, as may be desired.

* New York *Electrical Review*.

very short stroke. The crank shafts attached to the two pistons are so connected that the operative crank shaft

initial pressures varying from about 70 lbs. to about 220 lbs. can be tested. It has been stated by Mr. Dugald Clerk,

REVIEWS.

The Alternating Current Circuit. By W. Perren Maycock, M.I.E.E. Whittaker & Co.

This book impresses us as being an attempt to achieve the impossible, namely, to explain the theory of alternating currents in non-mathematical language. The author, we must admit, professes to teach the merest elements of the subject, but even this appears to be impossible, when he assumes that the concise and exact formulæ by which the laws of induction are usually expressed would be unintelligible to his readers. All the information conveyed in the first half of this book might be expressed in a few pages with far greater clearness and exactness, if the reader were assumed to have the necessary mathematical equipment. The reader who had thoroughly mastered this little work would find it difficult to work out the simplest problem in alternating currents.

The author concludes his book by saying that:—"This introductory book will have fulfilled its object if it helps the reader over the initial difficulties, and leads him to take up further and more serious study of the matter;" but we fear that further and more serious study will oblige him to unlearn some of the ideas he may derive from a study of this work. The ambiguity and vagueness which result from the popular method of exposition to which the author has restricted himself, must no doubt be held responsible for some of the apparent inaccuracies, of which we may give one or two examples. At page 64, we find it stated that reactance $\propto \frac{\text{induction, mutual induction, and frequency}}{\text{capacity}}$. From this one would naturally infer that in an alternating current circuit possessing capacity, inductance, &c., the reactance is inversely proportional to the capacity. As a matter of fact, the reactance is equal to $p\,L - 1/p\,C$, which is quite a different formulæ from the author's. Again, at page 82, we have the following somewhat misleading paragraph:—"It is hardly necessary to point out that what is here termed 'electrical resonance,' is merely the ordinary effect of capacity on an alternating current in circuits (or portions thereof) which happen to have considerable capacity and very little inductance, the result being a lead in phase of the current." When electrical resonance occurs in a circuit, the current is in exactly the same phase as the impressed E.M.F.

Nowhere do we find explicitly stated in this book the beautifully simple law of Neumann on which the whole theory of electro-magnetic induction is founded. Mechanical analogies borrowed from Prof. Forbes are described to show the nature of inductance, capacity, and ohmic resistance; but such illustrations we think make very little impression on the student, unless he has previously acquired some knowledge of the arithmetic of the subject; then they may be useful to fix his ideas. Our objections, as may have been seen, are more to the plan of Mr. Maycock's little book than to its execution. We think it may be read with advantage, along with a more advanced work. The subject with which it deals is difficult, and is every day becoming more important in electrical engineering.

Machine Shop Arithmetic. By G. Calvin & Cheney. The Practical Publishing Company, U.S.A.

This is a convenient collection of simple rules for calculation, and a little explanation on solving some of the simple formulæ in which the presence of a few letters is apt to terrorise the non-mathematical man. As a rule the non-mathematical man sees in the mere use of a letter nothing but "algebra." To him x and a or b is something to be avoided, and yet this same man will work out simple calculations such as $D^2 \times S$ if only they were printed at length as the stroke multiplied by the diameter twice over. He understands this, and can understand the formula if he will, but he simply won't try. The book before us aims partly at showing him how, and we wish it the success which it deserves. Its authors are men who have held positions which have showed them what is needed by many practical men.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—TORONTO, 1897.

A NEW METHOD OF INVESTIGATING THE VARIATION OF THE MAGNETIC QUALITIES OF IRON WITH TEMPERATURE.

By F. H. Pitcher, M.A.Sc., Demonstrator of Physics, McGill University, Montreal.

(*Communicated by* Prof. H. L. Callendar, M.A., F.R.S.)

Owing to the apparent lack of exact knowledge on the subject of the variation of hysteresis in iron with temperature, and as it is of some importance in the working of transformers, it was thought well to investigate the subject further.

At the same time it was intended to repeat the experiments of Hopkinson and others on magnetism at high temperatures by a different method and with higher fields. For this purpose a new method, devised by Prof. Callendar, was employed.

Description of the Method.

The specimen of iron in question was in the form of a wire, and was tested by the direct magnetometric method in the broad side-on position. The first intention was to insulate the specimen in a small and very thin platimum tube, heated by having a current passed through it. The temperature of the specimen was to be inferred from the resistance of the platinum tube over the length occupied by the iron wire specimen. The resistance was to be measured by the fall of potential between the terminals of very fine platinum wire leads, attached to the platinum tube at the ends of the above length.

In this way, if the tube were made considerably longer than the wire, the middle portion occupied by the wire would be very uniformly heated, and very exact values of the mean temperature could be obtained. The slack of the platinum tube when heated was arranged to be taken up by copper springs. To prevent oxidation of the iron wire specimen, and at the same time to promote a steady temperature throughout the length of the platinum tube, the whole was enclosed in a vacuum tube. The vacuum was maintained by a five-fall Sprengel pump, which was kept running during the experiment, and was assisted by a water-pump in the early stages of exhausting the tube.

With this method in view, a platinum tube was constructed from a strip of foil 20 cm. long, 2·95 cm. wide, and 0·00254 cm. thick. It was rolled around a mandrel 0·438 cm. diameter, and after annealing kept its dimensions without necessitating binding wires. The fine platinum leads are attached by winding their ends once around the tube and twisting up tight. A specimen of iron wire was threaded through mica wads of the same diameter as the mandrel, and slipped into position inside the platinum tube. The ends of the platinum tube were bound with bare copper wire to # 0 copper rods, and the whole carefully centred in a glass tube.

The tube was exhausted, and a preliminary test for uniformity of heating made before placing it in the solenoid. It was seen to be heated very uniformly up to 2 cm. from each end. The apparatus was then fixed in position in the solenoid, and the whole placed in position with respect to the magnetometer. It was found, however, that platinum tubes constructed in this manner from thin foil would not stand at high temperatures. Two others were tried, which, on account of not having thicker foil of sufficient length, had to be constructed out of foil of one-half the thickness—one being wound three times around the mandrel and the other five times. These shared the same fate as the first one, giving way in circular cracks running sometimes over one-half the width of the foil.

The initial extension of the copper springs was not more than 2 mm. in any case, and the ends of the tubes made as square as possible, so as to equalise the tension. This method was therefore abandoned until drawn tubes of suitable thickness could be obtained. In the meantime the platinum tube was replaced by the iron wire specimen itself, and in this way observations were obtained, and, by making the specimen its own thermometer, very exact values of its temperature could be obtained.

By heating the specimen in this manner there would be a strong circular field due to the heating current. The curves plotted from the temperature and magnetometer readings would therefore have to be corrected for this circular magnetism. This was effected in the manner explained, which, however, limited the temperature to which the wire could be raised. A set of observations was taken with the specimen in air and another in a high vacuum. The true magnetic behaviour of tha iron with temperature could then be obtained from these two sets.

Description of Apparatus.

The Solenoid.—The magnetising coil as made in the laboratory was wound on a brass tube about 70 cm. long, and having an outside diameter of 2·23 cm. The tube was fairly straight, and previous to winding was filed up and polished in a lathe and then carefully lacquered.

Winding.—

Length of winding	62·25 cm.
Depth „ (4 layers double silk covered # 24 B. and S.)	0·245 „
Whole number of turns	4,079·0 „
Total resistance	28·1 „

This winding was fed on by hand in a lathe, and was very fairly uniform. Each layer was carefully paraffined before winding the next. The insulation resistance when finished, as tested on 100 volts, was over a megohm. The winding was backed up at the ends by

square ebonite washers, which were fixed to the tube by brass set screws.

The Water Circulation.—A water circulation was arranged for dissipating the heat when large magnetising forces were used. A thin brass tube was chosen, so that if it were slipped into the solenoid tube the annular space between them would be about 2 mm. The smaller tube was centred by brass rings fitted at the ends to the annular space between the tubes. The joint was made tight by soldering. The water circulation was effected by two small brass tubes, about 0·75 cm. diameter, entering laterally throughout the solenoid tube beyond the ebonite end into the spaces between the tubes.

Combined Galvanometer and Magnetometer.—This instrument was simply a mirror galvanometer, mounted on levelling screws, and with two coils of copper wire fitted closely on each side of the needle The instrument was made fairly dead-beat by employing a large thin aluminium vane, just fitting the needle chamber, to carry the mirror and needle. The resistance of the coils was found to be 100·3 ohms at 18·7° C. It was used for measuring currents and resistances by the fall of potential method. The direct effect of the solenoid was balanced in the usual way by a balancing coil.

The Mounting for the Iron Wire Specimen.—The iron wire specimen was 26·1 cm. long and 0·127 diameter. Its ends were fused to copper wires 10·5 cm. long and 0·40 cm. diameter, an arrangement intended to conduce to a constant temperature throughout the length of the iron wire when the heating current was passed through the circuits The ends of the copper wire were riveted and tin-soldered to two ⌗ 0 B. & S. copper rods, which were brought out at both ends of the containing tube. The rods were at about 6 cm. from their inside ends, and copper springs, 3 strands ⌗ 18 B. & S., wound oppositely, were introduced to take up the slack of the specimen and copper wires when heated. The springs fitted the inclosing glass tube fairly well, but better centring was obtained by brass washers soldered on the 6 cm. segments at about 5 cm. apart and turned up to fit the tube.

Two fine platinum wires, for potential leads, were attached at 15 cm. apart to the iron wire specimen. They were brought out in glass capillary tubes running through diametrically opposite holes in the washers and inside the springs to one end of the glass containing tube. The ends of the capillary tubes were allowed to protrude about 5 cm. beyond the containing tube, and were fused at both ends to the platinum wires.

The diameter of the platinum leads was 0·005 cm., total length 93·0 cm., resistance 8·06 ohms.

The glass containing tube was made tight at the ends in the following manner. At the end where the capillary tubes were brought out, a large brass cup, 2 cm. deep and 2 cm. internal diameter, drilled through the bottom to fit the rod and capillary tubes, was threaded over into position, and soldered to the rod. This tube just fitted the inner solenoid tube, and had an internal diameter of about 1·27 cm. It was slipped over the apparatus till its end reached the bottom of the cup. The cup was then filled with melted fusible alloy, and to make tightness doubly sure, a mixture of beeswax and resin was run around all the joints. The other end of the glass tube was drawn down so as nearly to fit the copper rod, and a similar but, on account of having to go through the solenoid tube, smaller cup soldered to the rod, after putting a small initial extension of about 2 mm. in the springs.

The seal was made in the same way as before. The connection to the pump was made by means of a small copper tube entering through the bottom of the brass cup, and sweated in with solder. It was bent up at a right angle to facilitate a mercury immersion joint. The length of glass tube between the cups was 61 cm., which was about 2 cm. longer than the inner brass tube of the solenoid.

When the apparatus was in place, so that the specimen was symmetrical with respect to the solenoid, the small brass cup was just at the end of the inner solenoid tube. Three brass set screws, ranged symmetrically, were tapped through this end of the solenoid tube, and screwed down hard on the cup. At the other end of the solenoid tube a brass binding screw was soldered. This, with a similar screw on the adjacent end of the copper rod, formed the heating current terminals. By making the heating current return around itself in this way, its direct effect on the magnetometer was minimised.

A compressed fibre block was screwed to the copper rod near the ends of the capillary tubes, and vertical holes drilled side by side in it, to form mercury cups for the platinum leads. Twin wire leads of approximately equal resistances were brought from the terminals of the standard resistances in the magnetising and heating current circuits, together with a similar pair from the mercury cups at the ends of the platinum potential leads, to three pairs of mercury cups on the table near the telescope and scale. The readings for magnetising current, heating current, and E.M.F. over the specimen could be very conveniently and quickly obtained by dipping the ends of the galvanometer leads into each pair of cups in turn.

ON A NEW METHOD OF MEASURING HYSTERESIS IN IRON.

By J. L. W. Gill, B.A.Sc., of McGill University, Montreal.

(*Communicated by* Prof. Callendar, M.A., F.R.S., *to Section G.*)

When a specimen of iron is passed to and fro through a magnetic field without any motion of rotation, the direction of the field being reversed each time the specimen passes out of the field, the iron passes through a complete magnetic cycle for each cycle of motion, and a definite amount of energy is lost, due to hysteresis in the iron. Since energy is supplied only in the form of mechanical work upon the specimen, the hysteresis loss is, by the law of the conservation of energy, numerically equal to the resultant mechanical work expended.

The instrument described below is based upon the above principle, and its function is to measure the work so expended.

The magnetic field is obtained by the use of a solenoid wound on a brass tube. This solenoid is arranged vertically and has a vertical motion, the ends of the solenoid being fitted with collars, which slide on two rigid vertical rods. An arm is fastened rigidly to the solenoid, and extends out on one side. To this arm is fastened a cord, which passes over a grooved pulley vertically above. A balance-weight is attached to the other end of the cord. By rotating the grooved pulley the solenoid may be moved up and down, and will remain in any desired position. The specimen to be tested is placed in a stirrup, which is sufficiently small to pass through the solenoid, and is suspended by a helical spring, the point of suspension being vertically above the centre of the solenoid. Another helical spring extends from the bottom of the stirrup to a point vertically below. This serves to keep the stirrup steady. The stirrup is suspended so that when the solenoid is in its lowest position the specimen is out of the magnetic field, being above the solenoid. As the solenoid is moved up the stirrup and specimen pass through it, and when the solenoid is in its highest position the specimen is practically out of the field. If the solenoid be moved once up and down, the field being reversed when the specimen is out of it, the specimen passes through a complete magnetic cycle, provided the specimen has been once through the field, and is initially in that particular cyclic state.

As the solenoid is moved up, the specimen is attracted down, the force of attraction increasing until it reaches a maximum, when about one-half of the specimen is inside the solenoid. The attraction then decreases and becomes zero when the specimen is in the centre of the solenoid. Up to this point work is being done by the magnetic force. As the solenoid is moved up to its highest position the specimen is attracted upward, and work is done against the magnetic force; the attracting force becomes a maximum when the specimen is about one-half out of the solenoid on the lower side, and becomes zero when the solenoid is in its highest position. The maximum force in the second half of the motion is greater than the maximum force in the first half. The work done in the second half of the motion is also greater than that done in the first half, the difference being the work expended in taking the specimen through half a cycle. When the field is reversed and the solenoid moved down, the action is similar to that which takes place when the solenoid is moved up, and the resultant work done will be the same, provided the specimen is homogeneous.

The resultant work done on the specimen may be determined by observing the attracting force when the solenoid is in different positions, and then drawing a distance-force curve. The integral of this curve gives the resultant work done on the specimen. The force at different points can be determined by calibrating the springs which support the stirrup, and then observing the extension of these springs. The author has determined the hysteresis loss in different specimens at different inductions by this method, the extension of the springs being observed with the aid of a microscope.

To make this method practical, a simple integrating apparatus is attached to the instrument above described, by which the work done is integrated automatically. A glass disc is connected rigidly to the pulley which moves the solenoid, so that when the pulley rotates, the glass disc rotates in its own plane, which is vertical, the axis of rotation passing through its centre. The motion of the glass disc is therefore proportional to the motion of the solenoid. An arm is fastened to the stirrup which supports the specimen, and extends up to the glass disc. This arm supports a graduated steel disc, which is free to rotate in its own plane about a vertical axis through its centre. This steel disc presses lightly on the glass disc, the point of contact being at the centre of the glass disc. When the solenoid is moved up, the specimen is attracted down, taking the stirrip with it. This causes the steel disc to recede from the centre of the glass disc. A motion of rotation is then communicated to it by the glass disc, the speed of rotation depending on its distance from the centre; since its distance from the centre at any instant is proportional to the attracting force, and the motion of the glass disc is proportional to the motion of the solenoid, the speed of rotation of the disc is proportional to the work being done at that instant. The total amount of rotation is therefore proportional to the total work done. Consequently all that is necessary to test a specimen with this instrument is to place the specimen in the stirrup, move the solenoid up and down to get the specimen in a cyclic state, then take it through a cycle, and observe the amount of rotation communicated to the steel disc. This is a direct measure of the work expended.

The constant of the instrument is determined by placing a known weight in the stirrup, and observing the amount of rotation communicated to the disc when the solenoid is moved through a known distance.

The specimen may be taken through a number of cycles and the readings allowed to accumulate. The average of a number of cycles is thus obtained.

ON A NEW METHOD OF DETERMINING THE SPECIFIC HEAT OF A LIQUID IN TERMS OF THE INTERNATIONAL ELECTRICAL UNITS.

Before Section A. By H. L. Callendar, M.A., F.R.S., Professor of Physics, and H. T. Barnes, M.A.Sc., Demonstrator of Physics, of McGill University, Montreal.

In view of the probable adoption of the joule or watt second as the absolute unit of heat, it becomes of special interest at the present time to make direct determinations of the natural thermal units in terms of the electrical standards now universally adopted.

In recent years the specific heat of water has been very carefully

determined in this manner by Griffiths, and also by Schuster and Gannon. These observers employed the usual calorimetric method, in which a mass of water is heated through a carefully observed range of temperature by means of a measured quantity of electrical energy. Although their methods differed widely in points of detail, their results agreed to within one part in a thousand with each other. But, as Schuster points out, the result so obtained by the electrical method for the specific heat of water differs by more than one part in 350 from the result obtained by direct mechanical measurements of Joule, Rowland, and Miculescu.

Whatever the cause of this discrepancy, it seemed desirable to repeat the electrical comparison by an entirely different method, to avoid any possible source of constant error which may have remained unsuspected in the calorimetric method as usually practised.

The method which we have adopted consists in passing an electric current through a fine tube, through which a steady current of liquid is flowing. The electrical measurements required are the current and the difference of potential between the ends of the tube. The thermal measurements are the steady difference of temperature and the quantity of liquid flowing in a given time.

The electrical measurements are all made on one potentiometer, preferably a Thomson-Varley slide box, and present no difficulty, as it is easy to keep the current steady to one part in a thousand for an hour or more, and there is no change in the resistance of the circuit.

The difference of temperature between the inflowing and outflowing liquid, which is also very nearly constant throughout the duration of the experiment, is measured by means of a differential platinum thermometer. The instruments used for this purpose, consisting of a compensated slide wire resistance box and pair of thermometers, are the same as were exhibited by Prof. Callendar at the conversazione of the Royal Society in 1893, on which occasion the instruments were used for demonstrating the lowering of the melting point of ice under one atmosphere of pressure. Readings can be taken to the ten-thousandth part of a degree on a rise of temperature of 10°.

The current of liquid is kept steady by means of an automatic electro-magnetic device, and the quantity flowing in a given time, the interval being also automatically recorded on an electric chronograph, is determined by weighing.

It will be observed that in this method, as compared with that usually employed, since the temperature distribution is exceedingly steady, it is not necessary to determine the thermal capacity of the calorimetric tube with any degree of accuracy. The rate of external loss of heat is also much more steady and more easily determined, and there is no question of lag of the thermometers.

The external loss of heat, which is generally the largest and the most uncertain correction in all calorimetric experiments, can, in the present instance, be made extremely small and regular by the expedient of enclosing the calorimetric tube, &c., in a glass jacket, which is exhausted as perfectly as possible and then hermetically sealed, so that the vacuum cannot suffer further change. The loss can also be measured and eliminated in a very simple manner. If observations are taken with different values of the electric and liquid currents, the values in each case being adjusted to give the same rise of temperature, it is clear that the temperature distribution, and therefore the external loss of heat, will be very nearly the same. The total loss can be reduced to 2 or 3 per cent. of the heat supply on a rise of temperature of 10° C., and the residual differences in any set of observations are but a small fraction of the total loss, and are easily corrected.

We have so far applied the method only to the cases of water and mercury, which present most interest. There is no difficulty, however, in extending the method to the case of other liquids. We have made special arrangements for applying the method to the determination of the variation of the specific heat with temperature, for which purpose it is peculiarly suited, and was, in fact, originally devised. The apparatus may be inspected at the McDonald Physics Building. The essential parts will also be exhibited at the meeting.

SCREW GAUGE.

Second Report of the Committee to Section G, consisting of Mr. W. H. Preece (*Chairman*), Lord Kelvin, Sir F. J. Bramwell, Sir H. Trueman Wood, Major-Gen. Webber, Col. Watkin, Messrs. Conrad W. Cooke, R. E. Crompton, A. Stroh, A. Le Neve Foster, C. J. Hewitt, G. K. B. Elphinstone, T. Buckney, E. Rigg *and* W. A. Price (*Secretary*), *appointed to consider means by which Practical Effect can be given to the Introduction of the Screw Gauge proposed by the Association in* 1884.

At the meeting in Liverpool in 1896 your Committee reported that sufficiently accurate gauges of the British Association screw threads were not generally procurable. They described methods of exactly measuring male threads, and proposed a form of gauge for male threads which they anticipated could be more accurately produced, and more easily verified than the forms in common use.

In continuation of this course they have been in correspondence with some of the principal tool-makers in England and America, with a view to procuring accurate gauges of the different screw threads of the British Association system constructed on the lines indicated in their last report.

The Pratt and Whitney Company of Hartford, Connecticut, had already begun to construct tools for these threads, when the Secretary of the Committee wrote to them, and are giving close attention to their accurate production. The Company have kindly promised to communicate with the Committee as soon as the work is sufficiently advanced to allow them to make proposals for the supply of the gauges, and the Committee hope that exact gauges will soon be obtainable from this source.

In the meantime they ask to be reappointed, with a grant of £20, including the £10 granted last year but not drawn.

ON A RESEARCH IN THERMO-ELECTRICITY BY MEANS OF A PLATINUM RESISTANCE PYROMETER.

By H. M. Tory, M.A., Lecturer in Mathematics and Demonstrator in Physics, McGill University, Montreal.

(*Section A.—Toronto*, 1897. *Communicated by* Prof. H. L. Callendar, M.A., F.R.S.)

The paper is an account of some experiments carried on in the McDonald Physics Building of McGill College, with a view to applying the electrical resistance pyrometer to the phenomena of thermo-electricity.

The method was suggested by Prof. Callendar, whose work, with that of Messrs. Griffiths, Heycock, and Neville, has fairly well established the formulas for calculating temperature by this means.

The object of the investigation was to give a more rigid verification of Tait's parabolic formula.

The research, as conducted, naturally divides itself into three parts:—

1. The study of the usual form of copper-iron junction.
2. The study of a cast-iron wrought-iron junction. In conducting some experiments on the cyclical variation in the cylinder wall of a steam-engine, Prof. Callendar found a couple of this type most suitable.
3. A direct comparison of the electrical resistance pyrometer with the platinum-platinum-rhodium couple.

In all cases the compensation method was used for measuring the E.M.F., the junction being balanced against a storage cell, which in turn was continuously balanced against a Clark cell kept at constant temperature. A carefully calibrated rheostat and a resistance box, both of the same material were used.

The copper, cast iron, and wrought iron were tinned together at one end and heated in an oil bath, in which also was inserted the tube containing the pyrometer. The observations were taken only at perfectly steady temperatures. The direct reading galvanometer, devised by Prof. Callendar for the purpose, was used in taking temperatures with the pyrometer. A carefully calibrated resistance box of the standard type was also used.

The platinum temperatures were calculated from the formula

$$pt = \left(\frac{R_t - R_0}{R_{100} - R_0}\right) 100 \qquad (1)$$

and the air thermometer temperatures by means of the difference formula

$$t - pt = \delta\left(\left(\frac{t}{100}\right)^2 - \frac{t}{100}\right) \qquad (2)$$

The object being to show the relation between the experimental curve and Tait's parabola, it is quite obvious that the ordinary method of plotting the temperature and the E.M.F. is not sufficient. A difference method similar to that above—equation (2)—was therefore adopted. The values of t were taken as abscissas, and the corresponding values, $t - t_c$, as ordinates, t_c denoting the couple temperature, where $\frac{E_{100}}{100}$ is the temperature coefficient.

The relation to the parabolic formula may be shown thus:—

If

$$E_t = a\,t + \beta\,t^2 \text{ (Tait's formula)}$$

then

$$t - t_c = \delta\left(\left(\frac{t}{100}\right)^2 - \frac{t}{100}\right),$$

when δ is a constant depending on the nature of the metals. The value δ was calculated from the observed difference, $t - t_c$, at 200°. With this value for δ the parabola was plotted, passing therefore through three points on the experimental curve, those corresponding to 0°, 100°, and 200°. The accompanying curves show the differences from this parabola plotted along the axes.

In order to compare the Le Chatelier couple directly with the resistance pyrometer, the couple and the pyrometer were placed *in the same porcelain tube*. The couple was the usual form, a pure platinum wire coupled with another of platinum containing 10 per cent. rhodium. The wire was obtained from Messrs. Johnson, Matthey & Co. The junction was placed so as to be directly under the pyrometer coil, from which it was separated by strips of mica.

The temperatures, as before, were taken only at steady points. These points were obtained by varying the gas supply under a vessel containing molten tin, and by taking the melting point of tin, the boiling point of sulphur, and the melting point of silver. The curve in this case was also plotted against the parabola, the value δ being calculated from the observed difference of temperature $t - t_c$ at 979°. The temperature coefficient of the junction was in this case taken as $\frac{E_{500}}{500}$, so as to give the nearest parabola throughout the whole range.

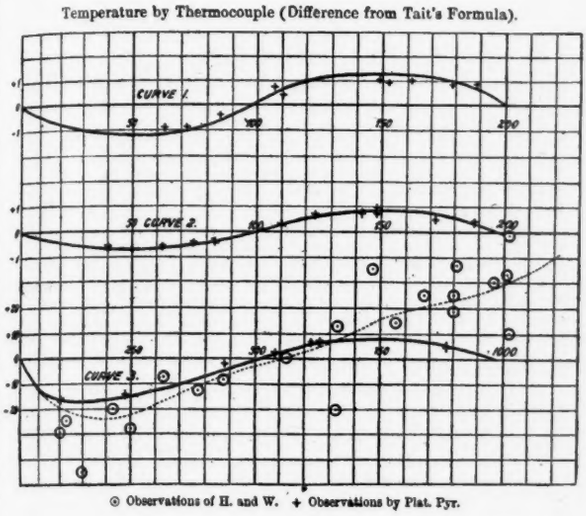
Curve I. shows the differences for the copper wrought-iron couple. The abscissas are temperatures by the air thermometer, the ordinates as before stated the differences from the parabola. The difference is $-1°{\cdot}1$ at 50° and about $+1°{\cdot}1$ at 150°.

If the temperature of the neutral point be calculated from the difference equation, using for δ the value found at 200, namely, $23°{\cdot}25$, then T_0 (the neutral point) = 265°. The experimental curve shows it to be somewhat lower than this.

Curve II. shows on the same scale the differences for the junction of cast-iron and wrought-iron. The differences are smaller in this case, and the curve more regular. The neutral point, calculated as before, is 917°, which lies entirely beyond the limits of the experiments. The value of δ is 5,765.

By reference to the thermo-electric diagram it will be seen that the line for cast-iron lies on the same side of the copper line as that of wrought-iron, but a little lower down.

Temperature by Thermocouple (Difference from Tait's Formula).



⊙ Observations of H. and W. + Observations by Plat. Pyr.

Curve III. shows the differences as before for the platinum-platinum-rhodium couple. The scale here for the abscissas is just $\frac{1}{2}$th that in the other two cases, and that of the ordinates $\frac{1}{10}$th. The greatest difference will be seen to be at 150°, the differences being much greater below 500° point than above.

The curve representing the formula of Holborn and Wein* has been plotted, and the differences from the same parabola are shown by the dotted line. Their observations are necessarily much less accurate than those taken by the resistance pyrometer, as is shown by the points marked ⊙, along the difference curve. This is owing, in the first place, to the difficulties in air thermometry work, and and also to the fact that the temperature was changing when the observations were taken. Their curve, though similar, shows the E.M.F. for the same difference of temperature to be considerably higher than in the present case, due probably to a difference in the composition of the alloy. Various other empirical formulæ have been suggested, but as they have no theoretical basis, they have not been considered. It is obvious that a straight line does not fulfil the conditions unless it be between points not very far separated.

Tait's formula, as far as it holds, perhaps simply amounts to drawing the nearest parabola, as the differences found in the present observations are quite beyond the limits of possible experimental errors. There seems to be no reason, however, to conclude that the formula may not represent the physical explanation of the effect, at least to a first approximation.

* *Wied. Ann.*, 1892, p. 107.

THE ENGINEERS' DISPUTE.

This unfortunate dispute drags its slow length along, and every day brings fresh news of continued follies. It appears that the leaders in the London district lightly undertook to upset the pre-existing harmonious relations of masters and men upon a vote taken from but one-fourth of the London district membership. Surely this was an insufficient reason for so grave a step. We hear from an employé at Messrs. Maudslay's that this shop has got practically its full quota of men, but they are now non-unionists. Work has ceased at Sheffield, the unionists having decided to strike, they have also issued a manifesto that this strike will cause them great misery, and so while striking they actually repudiate the responsibility. They may do this, but all the repudiation in the world will not ward off from their families the disasters which must inevitably come upon them.

In the meantime the masters' federation has received considerable influx of new members, and the parallel lock-out is extending. Be it remarked that the lock-out is described as cruel by the Union men, who nevertheless think it right and proper to spring sudden demands on the masters which cannot fail to have ruinous effect on many who, as is too well known, have been on the verge of the no profit line; for be it noted the Union has openly abandoned the pretence or profession it once made that eight hours are as good as nine in productiveness, and now deliberately proclaim their intention of making it necessary to employ more men. Seeing, however, that there cannot be obtained, or could not when the strike began, a single fitter or other workman worth his salt, the obvious inference is that what is sought to be gained is simply a less day and more overtime at increased rates. The pretence, too, that eight hours were only to be asked for London, because of its home distances, and so on, is a very shallow argument. The intention is to begin in London and force all the country into line, as pointed out by Mr. Sydney Gimson, the secretary of the Leicester Employers' Association. Why, if the unionists were making a national levy to support the London demand, can there be any harm in the employers joining in a national lock-out? Yet the one act is noble, the other a cruel tyranny. When the Union talk so much of cruel tyranny they ought to be careful as to such tactics as they pursue at, let us say, Chelmsford, where men who wish to work are compelled to desist by threats of ill treatment, and have even been assaulted by gangs of men and boys, who parade the streets and terrorise would-be workers. One W. H. Atherton writes in the *Standard* advocating a double eight hours' shift per day so that the use of capital would be extended over double the time, and the expense of the eight hours day would be met by the double output. We grant all his arguments, even to the extent of allowing that it would be agreeable to the men. We do not believe the scheme possible because we have lost faith in the intelligence and honesty of the men's leaders, and cannot bring ourselves to understand why the workmen have allowed themselves to be tyrannised by their leaders or by men of the Mann and Burns type, who are entirely out of touch with practical facts. The double shift proposal of eight hours each is a possibllity in England which would take a long time to adopt in other countries, for they have not yet got anywhere near to eight hours, nor would it for some time be possible in England because there are not men sufficient to do it; that is, there are not sufficient skilled mechanics to do the labourers' work of attending automatic machinery. There are thousands of ill-paid clerks and other men who are as capable of such work as the most skilled mechanic to whom two-thirds the wages of the so-called "engineer" would be a Godsend, and there are thousands of steam pumps, to instance one item alone of the machinery now imported from abroad, which would then be cheaper made in England, and the making of which would find in the tool and template department work for the skilled tradesman that he cannot now have because he refuses to allow machine tools to be used in England. The skilled mechanic now says in effect that he prefers to do labourer's work at 40s. 6d. per week than to earn 45s. or 50s. doing refined mechanical work in templates in order that starving labourers and clerks may earn 35s. This is the position taken up by the Unions.

Writing on the strike from West Gorton, "Pattern Maker" complains in a Manchester contemporary that the employers could get as much in 48 hours out of the men as they now get in 54, if they would only look after the men more closely. This admission that the men are deliberately shirking work does not come very well. A Trades Unionist in the same journal writes to complain of the kind which are now admitted to membership of the unions. At one time men had to serve a proper apprenticeship before being admitted members, and the Trades Unions were correspondingly respected. He deems it an insult to intelligent men to allow unskilled membership, and demands the abolition of the paid agitator; or, if this be impossible, that all and sundry, including district secretaries, should receive strike pay, and the members' wives should be allowed to decide whetner a strike be, or be not, started. They have to bear the brunt of the strike, and remain shut up in a stripped cottage with the children unfed, while the man is probably often in the cheerful inn.

The *Practical Engineer* would make a difference between the hours worked at a high pitch, so to speak, and under low tension. We fear this is not practicable. This journal is favourable to the gradual reduction of hours as a proper concomitant with the progress in labour-saving machinery that should afford a share of advantage to the worker. But it is upon this very rock that harmony has been upset. Labour has demanded the advantage, and refuses to allow the improved processes. The old-time resistance to improved methods of which our contemporary speaks have been renewed, and at Sunderland this very resistance has just been causing trouble. And it is because the American worker, usually a far less skilful man than the better trained Englishman, has recognised what machinery will do, that Americans can compete here with machine-made goods. It is only in and around Birmingham, where the employers have been able to introduce the modern system, that there appears to be felt little or no effect of the strike. The masters do not seem to join the federation, nor do the men appear to think yet of striking. Harmony prevails, and where do the working classes appear better off than in Birmingham? Where is there a better built, better paved or lighted city than Birmingham; and where on the employers' side is there more capital to spare for outside investment? The wealth of the master in Birmingham is coincident with the well-being of the men, and such must necessarily be the case at the present day, if permanence is to be secured.

Our contemporary, *Engineering*, points out that for the first time in history a general federation of employers has become a reality, and argues from this the gravity of the case. Centuries ago, when Spain threatened England with its Armada, there was most inadequate preparation for resistance, but when the Armada actually sailed up the Channel men went off in small boats all along the coast to volunteer at the last moment. So with the employers. Previously outstanding firms have joined in, because they see that unless they do so they will be lost. This attitude convinces our contemporary of the pressing reality of foreign competition, and if anything more were needed, surely it is the sympathy of 12 hours a day German workmen with Englishmen asking for eight hours? Why is the

German worker so anxious for us to work eight hours? Can he not spare some sympathy for himself and his Kaiser-ridden fellows, or is his "bounty as boundless as the sea," that of his infinity he can sympathise with men already working 25 per cent. fewer hours than himself? Yet the British workman swallows all this sympathy as genuine. Did he never read Æsop, we wonder, and learn to ponder upon the relation of the fox and crows? Two things, says *Engineering*, make men act together—discipline and danger. The unionists have the discipline by their very training. But also by their training the employers have no discipline, for they are too much accustomed to fight for their own hand. Is it not a sign of a common and great danger that the employers are acting so well together? Hitherto capital in England has been very individualistic, and labour has been collected and has attacked capital in detail Capital has now to some extent followed the same course, and labour calls the action cruel, and adopts an injured tone. Yet it has gone very hard with very many employers to lock out their men, with whom often they have been brought up side by side, and this is all the more proof of the appreciation of a common danger. If the great works of England are to be dominated by a few individuals in Blackfriars, it is time for masters to shut up shop, or combine.

It is not an unhopeful sign that the better end of the men are becoming aware that the bluster of Burns, Mann & Co., has for an end not the betterment of the men so much as the glorification of the man who does the blustering. To pay for men like [these and their attendants, London workmen who are working are paying levies of 4s. a week. The strike has lasted seven weeks—a strike which John Burns said he would have settled in a fortnight. This frothy talk encouraged the men to strike, and where are they now? England is supposed to be a free country, but we think that when men like Burns and Mann set about to curtail the freedom of men who wish to work by picketing and threats and actual assaults, it were no bad thing to give such men notice to quit England's shores, for those who refuse freedom to others, should not themselves be free. Why not, for once, follow the example of the rest of Europe, and dump our rubbish on their shores as they dump much of their dirt on ours? Burns actually invokes the aid of Parliament to make the eight hours' day legal, to legislate for grown men as though they were children and young persons. When Mr. Burns calls foreign competition a myth and a bogey, we do him at any rate the compliment of not believing him. We would not libel his intelligence by accepting that he is stating his belief. The *Standard* says it would not meet the case even if the men demanded only a proportionate wage for an eight hour day which they get for nine, for there is the question of idle capital. The reduction is about six weeks annually, and the output from capital is now so small that greater shrinkage of hours is naturally feared. Rent, taxes, and insurance already form a large percentage of the total cost of running a works. The percentage may vary from 5 to 25 per cent., and an addition to this will be a serious matter when interest on capital has also to be spread more thickly over production. The rottenness of John Burns' arguments was never more shown than in his denunciation of the blacklegs, as he is pleased to term free men. If the free men are worse than many specimens of Union men we have recently seen "working," then they must indeed be a sorry lot. Burns describes a "blackleg" as a man who wants £4 a week, and no work between meals. Could he have described himself in better terms? We believe it is years since he wrought at the bench at all, or handled a hammer, though he is said to be handy with his fists, and we all know he can talk.

On Saturday last, in Sheffield, the lock-out commenced at the following works:—Vickers, Sons & Co., Cammell & Co., Jno. Brown and Co., Firth & Sons, Jessop & Sons, S. Osborne & Co, and Edgar Allen & Co. In the Sheffield district the non-unionists, or blacklegs, as Burns calls them, are being given strike pay by the Union to keep them idle. Many shops in Sheffield are still working—probably on incompleted contracts—which may later be stopped.

Facts are more or less difficult to obtain. The A.S.E. publish a list of firms who are supporting them, having granted the eight hours. To say these firms support the A.S.E. is more or less of a fact; but it is about on a parallel with the claim that large numbers of men elect to live on Portland Isle simply because they are living there. It is doubtful how much the A.S.E. have so far spent on the strike. Some place the amount at over £170,000 already taken from the accumulated funds—taken, that is, from money subscribed for sick pay and old age pensions; and these same men, who have paid to that fund, are paying up to as much as 4s. weekly, as well as seeing their fund go down before their eyes. It is nothing less than scandalous that hard working men who have been paying for years should be deprived of their earned pensions by the action of a lot of so-called labour leaders. We know from personal enquiry how hardly this levy of about 10 per cent. is bearing upon the family men of the A.S.E., and it is reported that the younger men on strike pay are many of them enjoying a paid-for cycling holiday at the price of starvation of women and children. But it is the employer who is called cruel. Jno. Burns tried to show that he and Thos. Mann had been very moderate in their expenses. Can he show that the officials of the A.S.E. do not make a good thing of the strike? We think he cannot show this. He was very ambiguous, even in the figures he presented of his own and colleagues' expenses, and he referred to general labourers as the ragged regiments of unskilled labour, apparently forgetful that it was on the shoulders of such ragged unskilled labour that he himself got a big lift in the world a few years ago. His Hyde Park speech of Sunday last was all sound and fury and vulgar invective, and contrasts curiously with the tone of the better end of the Unionists, who are not in Jno. Burns's enviable position of living without work, and don't see the wisdom of the movement for which the men themselves were not asking, and for which they would not have forced an ill-timed strike, had they had a word to say in the matter.

THE TELEGRAPHISTS.

According to some reports the disaffection of the Postal Telegraphs Department has been added to within the past week by the lady telegraph clerks to the number of 850 or 900, being asked by the officials whether they would consent to work from 2 to 10 p.m. It is stated that the present departmental rules laid down hard and fast that the lady clerks should not work outside the hours of 8 a.m. and 8 p.m., and be free on Sundays.

It is understood that all but three of those approached on the question declined to fall in with the proposal.

There appear to be conflicting statements about this "grievance" also, for a lady telegraphist, referring to the subject, writes to the *Telegraph* as follows: At present nothing of the kind exists. Certainly there has been a rumour amongst us that we may be asked to perform a 2 till 10 duty, but no lady has yet been asked officially, and I think it will be time to cry out when we are hurt, not before. We work side by side with men during the day, actually doing the same work, and we receive a much lower salary, although many of us have been in the service longer than the men who are taking more money, the excuse being that as we do not perform the men's duties after 8 p.m., and occasional Sunday duty, we are not entitled to their pay. This is reasonable as far as it goes, and some of us have said in jest that if they would raise our salaries we might be willing to take the same duties. This may be the cause of the rumour being circulated. I think it would be fair to make this known. I am engaged in a section of the Central Telegraph Office where over 500 women are employed, and not one has yet been asked to perform the duty of 2 till 10.

A meeting of the London Executive of the Postal Telegraph Clerks' Association was held on Monday night, at which the Departmental request to the women operators to perform 2 to 10 p.m. duty was discussed. After considerable discussion, it was decided to write to the Postmaster-General asking for further information. As an example of the alleged cheese-paring policy of the Department, it was stated that on Jubilee Day several messenger boys were detailed for special duty, and were served with some slight refreshments, while during the last few days one of these boys was asked to refund 6d., the cost of these refreshments, the amount being deducted from his pay.

On Wednesday three female members of the London branch of the Postal Telegraph Clerks' Association, waited upon the Controller of Telegraphs and received from him an assurance that no alteration of their duties in the direction of 2 to 10 hours was contemplated.

A meeting of the Fawcett Association Executive was held on Monday night to discuss the Postmaster-General's circular, in accordance with the terms of the following resolution passed on August 16th: "That as the Postmaster-General's circular is not a reply to the various grievance brought under his notice, consideration of the same is deferred for a fortnight." The discussion was long and spirited; but although each speaker expressed great dissatisfaction, up to a late hour no definite decision had been arrived at. It was also announced that a meeting was being arranged in Birmingham during the sittings of the Trade Union Congress, to call attention to the Department's refusal to recognise the Association as a *bonâ fide* Trade Union, and to enlist the sympathy of the labour world in their agitation.

A memorial has been sent to Mr. Spencer Walpole on behalf of the Fawcett Association, calling his attention to "several instances in which they consider the Department has not yet carried out the recommendations of Lord Tweedmouth's Committee." The memorial states that "a fair interpretation of the Committee's recommendation would secure us 11 hours between each duty. The morning and evening officers only get eight hours." With reference to what are known as floating duties, the Committee recommended that continuous long duty should not exceed 10 hours in one day, followed by six on the next. "Contrary to this recommendation," the Department is still compelling men to sign a paper promising, if called upon, "to do 11 hours on some days and five on others." The memorial goes on to ask what facilities will be given them for earning the double increment. Proceeding, the Association draws attention to a case of alleged sweating in the following terms:—"In obedience to your request to be furnished with the name of the junior sorter who, it was alleged, performed important duties in the Registered Letter Section on a wage of 19s. a week, I have to inform you that his name is John Perrott. His case is not an isolated one. He is attached to the Newspaper Section and to the Registered Letter Section reserve. One important duty he has performed is a despatching duty in the Great Western Division. On this duty he made up and despatched registered letters to Bristol, Gloucester, Trowbridge, Newnham, Frome, Chippenham, Ross, and Coleford. He has also performed table duties, which, I am informed, are more difficult than despatching duties. On August Bank Holiday this officer performed the evening duty in the Registered Letter Section. His duty was despatching 'B' books in the suburban division. For this important duty, performed on a Bank Holiday, he received as extra pay the sum of 1s. 3d., that is 5d. an hour for the highest duties of a sorter's class."

Electro-Metallurgy in Germany.—The Allgemeine Elektro-Metallurgische Gesellschaft is the name of a company which has just been organised at Elberfeld, with a capital of £25,000, to acquire and exploit the Hoepfner Electro-Metallurgical patents, and to establish works for the production of copper and nickel by electrolysis.

THE LIVERPOOL TRAMWAYS.

The position we took up in a recent issue with regard to the appointment of an American engineer to design and supervise the proposed electric tramway for the Liverpool Corporation, has been abundantly supported by all the technical press; and we feel some amount of satisfaction in seeing that the Tramways Committee—whether influenced thereby or not—has by no means decided to give way in the matter, merely from deference to the chairman's views.

Seeing that no real reasons exist for Sir Arthur Forwood's resignation, when a *modus vivendi* is easily possible, we are not surprised to find that an arrangement satisfactory to both sides in the meantime was concluded at the meeting of the committee on Tuesday last. His proffered resignation was not accepted by the committee, a motion being passed by 14 votes to 4 to this effect.

Subsequently, the committee decided that "Mr. Pearson be engaged in a consultative capacity if desired by the committee." It then resolved to adjourn until to-day, when Mr. Oulton will move that Messrs. H. G. Harris and G. C. Cunningham be appointed electrical engineers for the proposed scheme.

The course that events are thus taking would appear to be as good as any for allowing both sides to get out of what was a decidedly unpleasant business: it affords the chairman an opportunity to resume his seat gracefully, while, at the same time, giving full scope to the wishes of the majority. Ill-natured people might consider it a climb down for both chairman and committee, more temporary perhaps on one side than the other in view of the resolution subsequently carried. Be this as it may, we are pleased to see that the Committee value its chairman's services sufficiently highly to be very unwilling to lose them; to such an extent it gives way to him.

In the next place we note with satisfaction that it was decided not to definitely appoint Mr. Pearson with a free hand, but that he should be engaged as consultant only if the Committee wished it. This scores one for the Committee which does not see why the majority should be overruled even by the chairman.

Evidently the committee does not desire to appoint Mr. Pearson even in a consultative capacity if we are to judge from the third item in the programme of Tuesday's meeting, when the vice-chairman gave notice of a motion to appoint two entirely distinct engineers; but we do not pretend beforehand to gauge the result of a vote upon such a motion. So far as these two nominees are concerned we have nothing much to say about them, except that Mr. Cunningham hails from Canada instead of the United States and therefore deserves, *ceteris paribus*, somewhat more support than the latter. But why go across the Atlantic at all, even to the colony that lies closest to the mother country? There ought surely to be enough development in Canada to engage all the efforts of its most capable citizens, and that they are capable the present year of grace (we nearly said, of Jubilee) has proved repeatedly.

Mr. Harris occupies a prominent position in the general engineering world, but we do not know that his particular experience in electric traction has been of great value. At the same time the work would doubtless be safe in his hands, for it is not difficult even in this early stage of electric traction development for prominent engineers to find capable assistants who can safely be trusted to look after the actual work in every direction.

THE BRITISH ASSOCIATION.

[FROM OUR SPECIAL COMMISSIONER.]

In Section G, on August 20th, Prof. Silvanus P. Thompson described a new form of photometer. A plane surface is pivoted on a vertical axis in its own plane, dividing it into equal parts. These are illuminated by the two sources of light under comparison, placed so that their directions seen from the axis of the plane surface are horizontal and at right angles. Then the illuminations of the two halves of the surface are proportional to the intensities of the two sources, to the sines of the angles between the plane surface and the directions of the sources, and inversely proportional to the squares of the distances. By rotating the plane surface until the two halves appear equally bright, a comparison between the intensities of the sources is made. In practice the two sources to be compared, placed against two adjacent walls of a room, illuminate the two halves of a board covered with white blotting paper inside a box fixed in the corner of the room. The board can be rotated about a vertical axis by a handle placed outside the box, and is viewed through an eye-hole. When the board is turned into such a position that the two halves appear equally illuminated, the ratio of the intensities of the sources is the tangent of the angle between the board and one of the walls of the rooms, multiplied by the inverse ratio of the squares of the distances. The method is stated to be very convenient. The apparatus had been used to examine the opacity of a bundle formed of a large number, as many as 40, of thin glass plates. Such a bundle is found to be very opaque to light falling nearly normally on the surface, but transparent light falling at an angle near the polarising angle.

In the same section, on August 23rd, Mr. J. G. W. Aldridge read a paper "On the present Tendencies of Electric Tramway Traction." The paper consisted of two parts: the first part was devoted to a discussion of the general advantages and disadvantages of the different systems in use for electric tramcar traction, the overhead trolley, the open and closed conduit systems, and the accumulator system. No tables of the details of expense were given, but a general conclusion was drawn that, except in certain special cases, the trolley system must inevitably become in Europe, as it has in America, the accepted system; and this both on the grounds of cheapness and convenience. The objections found to it on grounds of æsthetics, and the convenience of the fire brigade, were considered, and the author expressed an opinion that only time was required to overcome them.

The second part of the paper described a method of working a street tramway invented by the author to meet those cases where overhead wires cannot be used.

The author proposes to erect near the side of the track, at intervals of either 20 or 40 yards, iron posts carrying contact pieces connected with the feeders. A long conductor on the top of the car makes contact in succession with these contact pieces as the car travels along, and through this the current passes to the motors, the rails being used as a return in the usual way. In the case where the posts are 20 yards apart, and the car is of such length that a conductor exceeding 60 feet in length can be carried on the top, the conductor will touch a new contact before it has left the last, and a circuit will be maintained through the motor without interruption. If, however, the street authorities do not allow the posts to be so numerous, and they have to be spaced 40 yards apart, the author proposes to place insulated contact studs in the roadway, making contact with a long rubbing piece placed underneath the car. The studs are to be placed in connection with the feeders, or disconnected from them by switches on the post actuated by pieces fixed to and projecting from the cars, so that the stud is only "alive" while the car is actually over it, and is connected as soon as the car leaves it. By this means shocks to horses or foot passengers are to be avoided.

The advantage claimed for this system is, that it saves any visible street wiring, while the author proposes to utilise the poles, placed 40 yards apart, for the ordinary street lighting.

The expense is estimated at 25 per cent. beyond the usual trolley system.

This was followed immediately by a paper "On Electric Railways in Cities," read by Mr. Grenville C. Cunningham, M.Inst.C.E., manager of the street tramways in Montreal.

In the discussion which followed on these two papers, taken together, Prof. J. Perry gave a description of an interesting method of working street tramways by alternating currents devised by himself. Between the two rails of the tramway line are placed a series of pieces of sheet iron of channel section. Each piece is placed vertically

in the roadway, its plane being at right angles to the line of rails. The pieces are placed near together, magnetically insulated, forming an iron channel along the whole length of the line. The upper surfaces of the pieces are in the road surface. A flat slip conductor is laid along the channel thus formed and the whole filled in with cement. When an alternating current is passed through the conductor the pieces of iron sheet become magnetised, but in a continually changing direction.

The car carries an armature, wound with a coil, having projecting pole-pieces presented to the alternating electro-magnet in the bed of the roadway. The current induced in the coil is employed to drive the motors.

No illustrations were given of this apparatus beyond a rough sketch on the blackboard, but it was explained that the arrangement has been satisfactorily tested on the full-size scale on a very short line.

The cost of constructing such a line had been estimated, and was calculated to be much below the cost of a conduit line.

Prof. S. P. Thompson described a system of working a tramway line with contact studs in the roadway, connected by means of an electro-magnetic switch to the feeders when the car is over them.

Mr. Scott, of the Westinghouse Company, described their method of working. Two rows of knobs placed between the rails are placed in contact with the poles of a storage battery carried in the car. The circuit thus completed actuates an electro-magnet, which connects the knobs to the feeders.

The discussion was continued by General Webber, Mr. Tremlett Carter, Mr. Hawkesley, Prof. Hudson Beare, and the President of the section, Mr. Deacon.

CORRESPONDENCE.

Leeds Tramways and American Practice.

I notice that in your description of the Leeds tramways, you hint at the feeling of irritation due to the Americans monopolising so much of our electric railway and tramway work. As we are ourselves principally to blame for the backward state of electric traction experience in this country, it hardly becomes us to grumble at the American engineers coming here, giving us the benefit of their experience and importing apparatus and patterns, which we shall no doubt improve upon in the same way as they improve and alter our goods—for the simple reason that two heads are better than one.

We, in fact, owe a very great deal to our engineering cousins, and I was personally very pleased to see that in your reference to the pioneer Roundhay electric tramway you acknowledge this; more especially so after the exceedingly shabby way in which the Leeds Corporation treated the company who put it down.

I cannot help thinking that the line you took up with regard to the proposed appointment of Mr. Pearson at Liverpool was wrong. We take Spanish anarchists and Polish jews with no useful knowledge, except the most primitive agriculture; we even take educated Germans, yet object to one of the best tramway experts in the world. If a Forbes went to America, why should not a Pearson or Parshall come here. In the old days we understood these things better, and invited the Flemish weavers and Hougonots to come over so that we might learn from them. Have we, then, so far advanced that there is nothing more for us to learn. Surely it is the other way about; don't let us spend time grumbling at the American machinery—even pig-iron and tinplate—coming here, but rather try and find out how it is so great an engineering advance has been made in the comparatively short time since the Civil War. The best men America can produce are the men we are most likely to learn this from, and I think it would pay us, as a nation, in the end to not only get them here, but to make them so comfortable that they stay and become Britishers again. I know that they will also bring a number of younger men, and so may interfere with some of our prospects, but I also believe that they can recognise pure grit wherever it was raised, in fact, I am not at all sure that that isn't one of the principal reasons why the Americans get along at such a rate. All nationalities go to the States, and they simply sort out the best men.

Referring back to your description of the Leeds tramways, I would point out that the armatures and commutators of the motors were not made by Messrs. Greenwood & Batley, Limited, but were imported from America, as also were the motor controllers, which form, perhaps, the most brainy piece of work in an electric tramway equipment.

Ernest Kilburn Scott.

Cable Testing.

The following practical application of Price's system of testing with a guard ring, as described in your issue of December 6th, 1895, may be of interest. During damp weather, or when testing in damp places, considerable trouble is experienced owing to the moisture collecting on the instruments causing them to leak badly, rendering accurate testing impossible. It will generally be found that the greatest trouble is with the galvanometer, as while the keys and shunt box may be insulated by placing them on blocks of paraffin wax, it is difficult and undesirable to move the galvanometer to take this special precaution, and despite any amount of drying the galvanometer persistently leaks. This trouble may be avoided in the following simple way:—Connect the levelling screws of the galvanometer together and join them to the insulated terminal of the battery key. Of course, the galvanometer will require to be insulated to avoid short-circuiting the battery, but this is already usually done by standing the galvanometer on ebonite buttons, or suspending it by rubber tubes. This guard ring method succeeds where the ordinary methods fail by reason of moisture on the surface. Of course, the same system might be extended to the shunt box, &c., due care being taken to avoid accidental contact. During recent damp weather a leakage of 200 scale divisions with 750 volts was reduced to one division by this method, thus saving a considerable loss of time.

H. Savage.

Henley's Works, North Woolwich, E.
August 30th, 1897.

The Rapid Cable.

I have read with considerable interest the various communications which have appeared on the subject of leaks applied to a submarine cable to increase the speed of working. A great deal depends on the adjustment of the recorder coil, since any gain in definition may easily be obscured by the coil not being properly controlled for that particular class of signal. For range of adjustment in this respect I find that the old Thomson weight bifilar control meets all requirements, but it has the defect that the adjustment is not continuous. My own experience of one leak in the middle of two cables is that the signals are much squarer although the beats are not any more distinct.

Respecting a different type of cable, I expected to see some mention of the distortionless circuit of Mr. Heaviside, obtained by a given relationship between the resistance, capacity, inductance, and leakage of the circuit. Referring to pages 413 and 414 of "Electromagnetic Theory," Vol. I., we find there the two simple formulæ for the distortionless circuit, and the remark that inductance is wholly beneficial in diminishing attenuation and distortion of signals. On page 443, he suggests loading the dielectric with finely divided iron for the purpose of increasing the inductance. It would be most interesting if this, or some other method, could be put to a practical test. It might be anticipated that such a dielectric would have a low specific resistance, and, consequently, its properties would operate in two ways to diminish the distortion. I venture to enclose a small sample of a magnetic sand (interesting in itself) found on the Pacific coast of Central America, such as could probably be used in making up the magnetic dielectric spoken of.

I should hesitate to say that the question of the practical efficacy of uniformly distributed leakage has been decided. Until an artificial line with this sort of leakage shows no increase in definition, the matter cannot be taken as definitely settled. So far as I can see, the greatest trouble in the tests

would be with the receiving instrument. It must have a wide range of sensitiveness, and the natural swing of the coil must also be adjustable through a wide range to enable it to pick up the incoming waves to the best advantage.

A. Davidson.

Lima, Peru.

Willard Storage Battery Launches.

I observe in your issue of the 13th, a notice *re* the above, and as electric launches in this country are causing a certain amount of interest at the present time, it would be interesting to know the weight and capacity in ampere hours of those said cells, as 14 miles an hour for an electric launch of this length, draught, and beam, is to use an American expression "going it a bit."

D. F. A.

August 28th, 1897.

The Postal Telegraphists.

From the tone of your footnote to my previous letter, I have been expecting utter annihilation in your present issue. I am glad to find that apart from the clothing of your statements your thunder has passed me harmlessly; you commence with a Latin quotation. Here is another. *Magna est veritas et praevalebit.* Relying upon that motto, the telegraphists have swept away many of the hardships under which they suffered, and they hope to live to see a clean sweep made of the remainder.

The telegraphists may have erred in not presenting their case in the best possible way, but I join issue with you in saying that their recent failure is "due largely to misstatements caused by a want of proper advocacy on the part of the telegraphists." They have kept strictly to facts on the main points at issue, and it is as clear as noonday that the authorities have ignored those facts. You are welcome to the opinion that the authorities are desirous of doing justice, and I am equally welcome in refusing to believe anything of the kind. I still think the authorities ignore plain facts. You say that that argument might be used by the authorities. Possibly, but the facts that we ignore are such as, that because the telegraph branch does not pay its way, therefore, we must be underpaid. Had we respected such facts as the authorities would wish us to do, we should probably have still been in the enjoyment of the five or six classes in which Mr. Fawcett found us, when it took a man *seven* years to rise to 21s. a week, and after waiting there a few years, six years more, to rise to 27s. We should have been working on Sunday *without* pay, and so on. What the authorities want is automatons, who will be thankful to be allowed to live on any terms. At any rate, we have met with the same determined opposition to every demand, and so it will be until we get a Sir Alfred Milner, and then at a cost of a few thousands out of the three thousand thousands surplus revenue of the Post Office we shall have a contented staff.

Now with regard to the £190 maximum, it is, to use a favourite word of your own, "absurd" to ask us to quote from 1882 or any other estimates to show that that was the maximum created by Mr. Fawcett. It should be sufficient to accept the advertisement of Mr. Fawcett in 1882 that the scale was "to advance to £45 a year, rising by £5 a year to £100, with a prospect of obtaining £190." Mr. Fawcett distinctly speaks of the £190 class as among the general body, and Assistant Superintendents and Superintendents as "ranking above the general body." Could anything be clearer than that *as telegraphists* they had the prospect of rising to £190. There is no mention whatever about bars or pauses, the boys were left to find that out to their sorrow, later. The bars to promotion from class to class were, however, simply "seniority combined with efficiency and good conduct" when a vacancy occurred. Was not that sufficient to satisfy all reasonable demands?

If the first telegraphist who has reached £160 has performed the duties of the next class efficiently, why should his advancement be stopped because the authorities require him to do something which they did not inform him he would have to do until he had been in the service for 20 years?

I referred in my last to the maximum of telegraphists having been reduced to £160, at which point a technical bar was placed. Seeing that there have been few, if any, promotions, to the next class since that bar was introduced it sounds exactly like the official style of conducting the inquiry to ask where are the men of 25 or 30 years service, who have been stopped at the maximum limit in consequence of their being unable to answer such questions. The men of 25 or 30 years' service have been waiting for vacancies in the £190 class, and are being kept waiting until their seniors die, resign, or get a pension 20 years hence. I still say why should these men, after waiting for years for a vacancy, have their advancement stopped because they cannot pass a technical examination on subjects, some of which may never be of the slightest practical use to them.

I have drawn more encouragement from your omissions than your statements in your leader—you do not deny that there are at least some lower division clerks whose work is in no way more important than ours, and you no longer make use of the offensive comparison of telegraphists to machines. Thanks.

With very great respect, the "awful blundering" of the Government in 1870, and since that date, has everything, or nearly everything, to do with our case. It is the huge debt created in 1870, and since increased by some seven millions which has kept the department from paying its way, and every demand for money is directly or indirectly met with that reply. Every office must show that the receipts bear a certain proportion to the expense before any further expense can be entertained. It is not a question of what staff is required, or what senior appointments are required, but, has the proportion of receipts to expenses been exceeded, when a question of expense arises. It is, therefore, most emphatically the "awful blundering" that has nearly all to do with our case. While nominally the sorting and telegraph departments are treated alike as regards scales, &c., the sorting branch pays so much better, never having had a millstone debt about its neck, that when a question of promotions arises the sorters seem to get on so much better than the telegraphists. There seems to be no difficulty in seeing that a superior duty *is* is a superior duty in the sorting branch, but in every telegraph office of importance a number of men are continually employed on superior duties without extra pay, and every application is met with stubborn refusal, because the telegraph branch is not paying its way. To add to the many burdens laid on that branch, we have now got the free delivery of telegrams. How much better would the few thousands thus presented to the public have been employed in redressing the grievances of the men who earn the money to pay for this free delivery.

Moreover, did not Mr. Hanbury state in the House of Commons that the delay in replying to the telegraphists was due to motives of economy. Further, the officials approve of the Tweedmouth Committee Report, and was not the committee instructed to bear in mind the *revenue*. *Economy*, then, and *not justice*, is the guiding principle of the department.

Now as to the demands of the men. In London they want a maximum of £230, with no barrier until £175. In the provinces a maximum of £200. There is no ambiguity about that, I trust, and don't be horror-stricken at the idea of all rising to that maximum. The authorities have it in their power every year when the increments are due to prevent useless, or badly-conducted men from rising higher, but we contend that all well-conducted efficient men who perform their duties satisfactorily should rise to those maxima in a reasonable number of years.

There is a powerful argument in favour of increased pay, but knowing how hopeless it would be to urge it officially, it is being used for another purpose. Sixteen per cent. has been and is being stopped from our pay to provide us with pensions. Formerly, only 5 per cent. was stopped and the pension was some 83 per cent. of the wages; now with the higher stoppage we only get 66 per cent. of our wages. Now if we all lived to receive a pension we should only be receiving a portion of the pay which was deducted from us. But what are the facts? Only some 30 per cent. of the entire Civil Service live to receive a pension. Of this number some 12 per cent. die yearly, so that only a small number live to receive a pension for ten years. If the Government will not increase our salaries because of the stoppage for pensions, then they are in justice bound to hand

us or our representatives the balance of our pay on retirement or death. The honesty of a system whereby 16 per cent. of their wages is stopped from men, 70 per cent. of whom never receive a pension, should form an excellent subject for a leader if you can at any time see your way to consider the matter.

Telegraph.

[This letter is dealt with in our "Notes" columns.—Eds. Elec. Rev.]

As a telegraph man of over 20 years' service may I be allowed to ask "Junior" if, for a moment, he believes Mr. Lewin Hill's statement, that "a man of average ability could learn telegraphy in three months," cannot be supported?

Cable.

The "Economic" Boiler.

My attention has been drawn to the rate of evaporation given for the "Economic" boiler in the recent paper read before the Municipal Electrical Association. I shall be glad to point out that the figure given was taken from the "week in-and-out" evaporation of those boilers at a large London station, and therefore included the banking losses, &c., and is obviously an unfair figure to place beside the test figures and other boilers; an evaporation of over 12 lbs. per lb. of coal from and at has been obtained on tests taken by a most reliable authority. I shall be much indebted to you for inserting this in your paper.

John F. C. Snell.

Sunderland Electric Light Station,
September 1st, 1897.

THE TELEGRAPHS OF THE UNITED KINGDOM.

By CHARLES BRIGHT, F.R.S.E.

I.—Introductory.

It was on June 10th, in the year 1837, that Cooke and Wheatstone's first patent for "Electric Telegraph Alarms" was signed by His Majesty King William IV. and received the Great Seal. The first practical experiment took place on July 4th of the same year when Cooke laid an underground telegraph between Euston and Camden Town Stations, beneath the permanent way of the London & North Western Railway Company (then the London & Birmingham Railway Company.)* This line was composed of five wires (connected up to the five-needle instruments as above and made a total length in series of 55 miles. Each wire was laid in separate grooves previously cut into long blocks of wood. Several specimens of this wooden line are in existence. One was dug up but a few years ago, and this was made to form a portion of the circuit through which the Queen signalled to her people throughout the British Empire, from Buckingham Palace on Jubilee Day, June 22nd, 1897. Mr. Preece has recently published† some interesting particulars regarding this line, and it should be remembered that the Jubilee of Practical Electro-Telegraphy is contemporaneous with that of Her Majesty's reign. As that *doyen* of telegraphy, Mr. W. T. Ansell, lately remarked when calling attention to the above "What mighty results from small beginnings!"

In connection with the Diamond Jubilee of Electro-Telegraphy, it has been thought that a few notes *apropos* of early telegraphic days might not be without interest.

At the present time, all the British and Irish landlines are owned, worked, and maintained by the State, acting through its Post Office Telegraphic Department. The same applies to the submarine cables between Great Britain and Ireland. Those between Great Britain and the Continent (with the exception of the "Great Northern" lines) are the joint or separate properties of this nation and its neighbours. Thus, the working control and maintenance of the cables between England and France are shared by both Governments, while those to Holland and Belgium are entirely under British control, and are British property. In the case of the four Anglo-German cables, each country in question owns one exclusively, the others being the joint property of the two countries.

The cables between England and Scotland on one side of the Channel, and Ireland on the other, each contain several insulated conductors, and are of more than purely national importance, since they constitute (together with the Irish landlines) the connecting links between H.M. Government landlines in Great Britain and the various trans-Atlantic cable systems which make their points of departure in Ireland. Some of the conductors enclosed in these cables are, therefore, leased by the different Atlantic companies.

It was in 1870 that the State finally entered into possession of the various telegraphic systems (land and submarine) throughout and between Great Britain and Ireland. In 1889, by arrangement with the French, the two governments concerned took over those of the Anglo-Continental cables which were at that time the property of the Submarine Telegraph Company, and had been heretofore worked and maintained by that company, under a 40 years' monopoly concession then expiring.

With the above preliminaries, we may now proceed to survey the earlier history of United Kingdom electro-telegraphy.

II.—The Private Company Era.

It may be remembered that, in 1849, a concession for 10 years, afterwards extended to 40, was obtained by a party which became (the following year) the Submarine Telegraph Company. This was granted subject to a practical demonstration of the feasibility of the project within 12 months, which feasibility was just proved within the allotted time.

The Submarine Telegraph Company was thus the first company to promote submarine telegraphic communication. Their first engineer was Mr. Charlton J. Wollaston. He was succeeded by Mr. T. R. Crampton, later by Mr. J. Bordeaux, and still later by Mr. J. R. France.

Previous to its absorption by the State, our internal telegraphic system had been mainly controlled on the one hand by the Electric and International Telegraph Company, and, on the other, by the British and Irish Magnetic Telegraph Company.

These two companies had—so to speak—sewn the seeds of telegraphy in this country, having been the first to establish telegraphic communication between our principal towns for the transmission and interchange of public messages.

The Electric Telegraph Company was established in 1846,* having obtained exclusive rights for establishing telegraphs along nearly all the English railway lines. Thus, their system — contracted for by Reid Brothers — was almost entirely constituted by *overhead* wires, excepting in Ireland round about Cork and Wexford.

In 1853 the International Telegraph Company was formed for the purpose of securing concessions from Holland for cables between England and Holland, and as a result telegraphic communication was established by the International Company between these countries by means of certain Anglo-Dutch cables, made and laid for them by Messrs. R. S. Newall & Co. The International company was promoted by the same financial group as the Electric, with a view to their respective cables and landlines working as one system. Later on it was determined still further to consolidate the two by bringing them under one control. This was done in 1856, the title given to the amalgamated concern being The Electric and International Telegraph Company. The second epithet, however, was very soon dropped in practice.

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* Cooke had previously prepared a telegraph system for the Liverpool and Manchester Railway—the first great railway, opened for traffic in 1832.

† See a communication by W. H. Preece, C.B., F.R.S., *Journal* Inst.E.E. Vol. xxvi., p. 633.

* By Mr. Cooke (afterwards Sir William Fothergill Cooke) and Mr. John Lewis Ricardo, M.P., Chairman of the North Staffordshire Railway. This company began business on January 1st, 1848, between London, Birmingham, Manchester, Liverpool, and other large towns. As has already been shown, Cooke and Wheatstone's telegraph had for some years been worked by the railway companies—notably on the Great Western line between Paddington and Slough—partly for their own purposes, partly for the transmission of public messages. It took a long time, however, for the public to regard the invention in the light of a profitable commercial business; and when Mr. Ricardo did so, his action was regarded as somewhat speculative.

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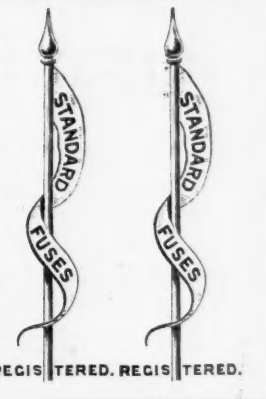

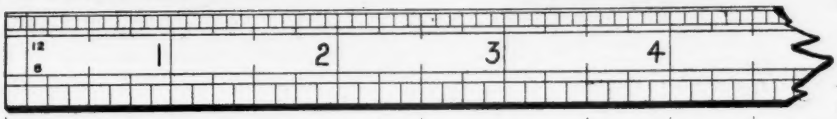

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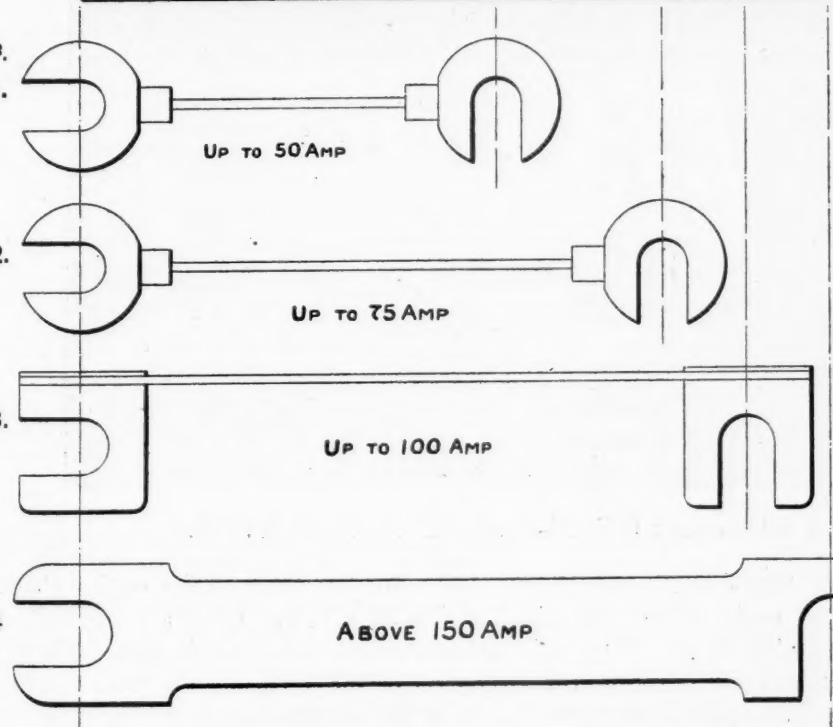

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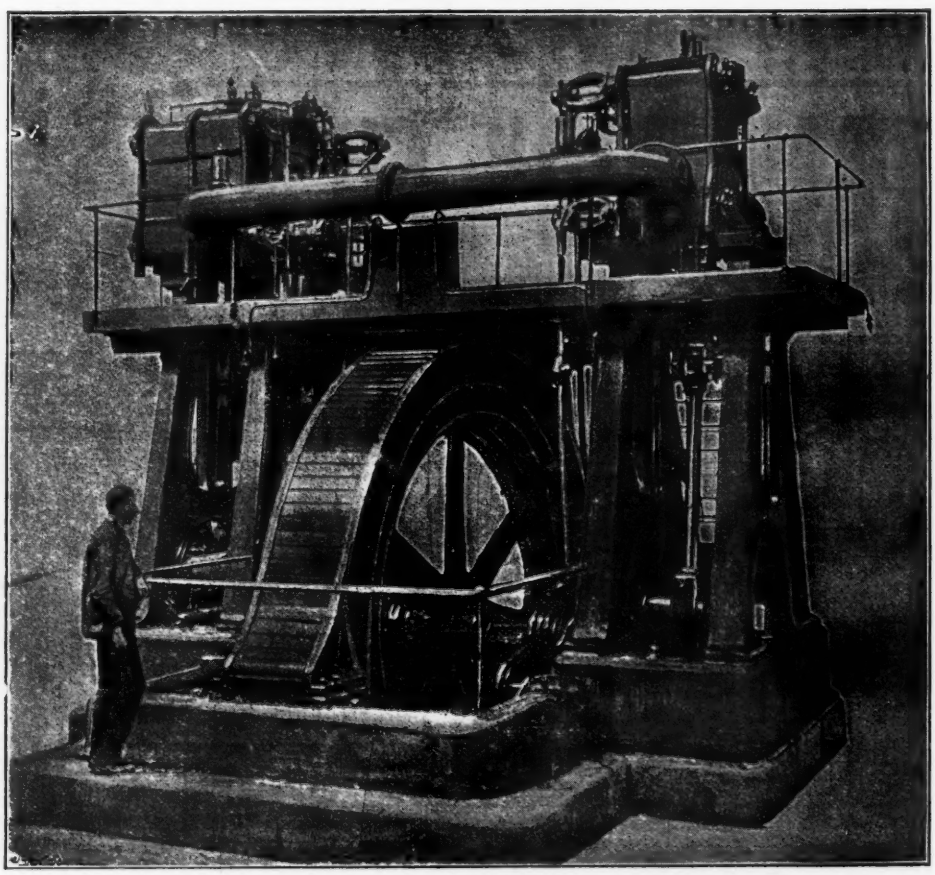

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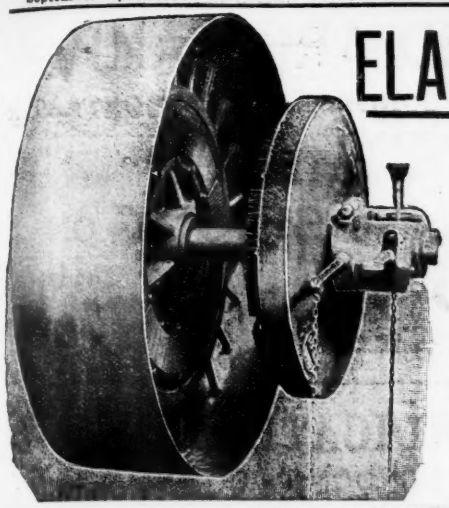

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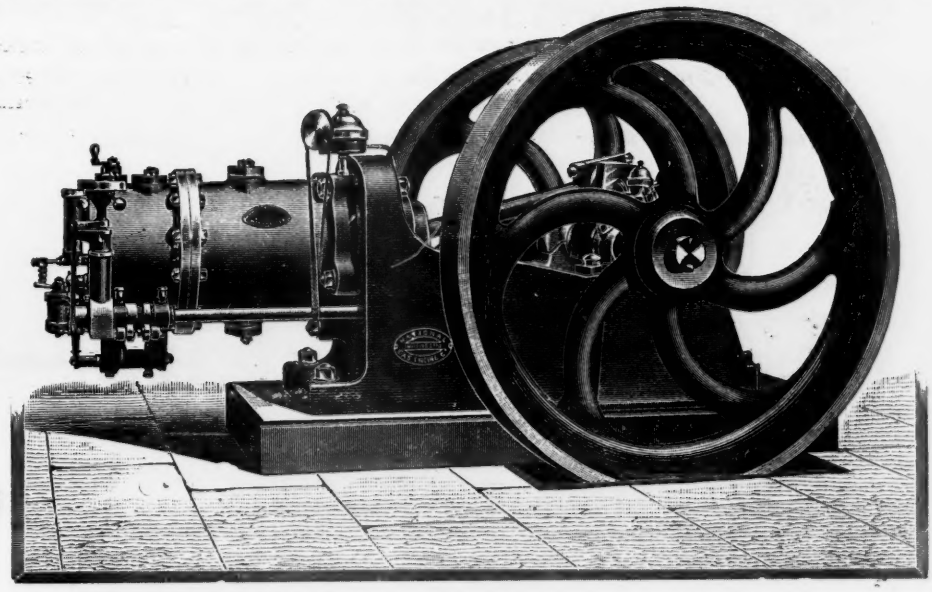

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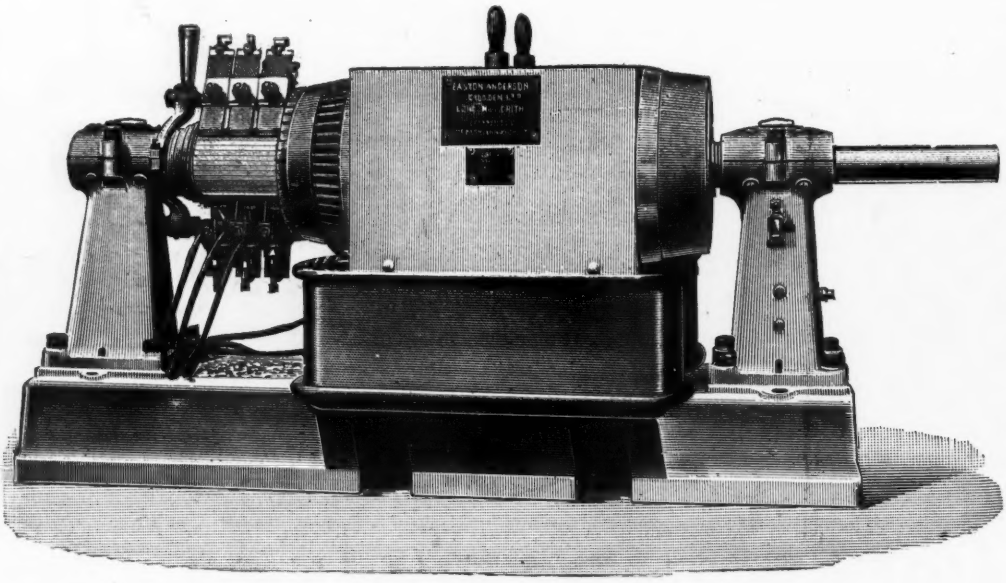

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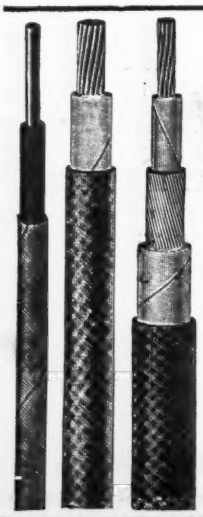

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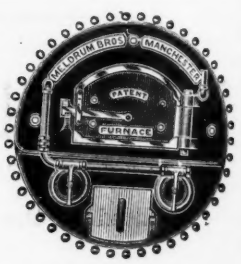

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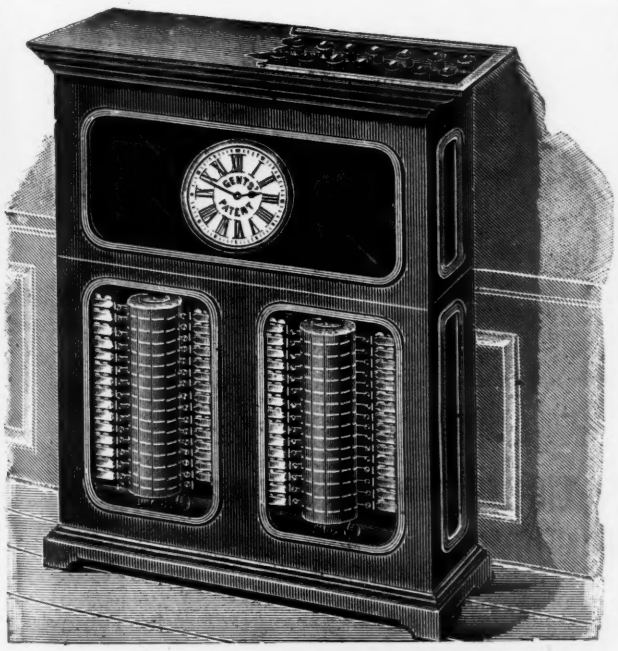

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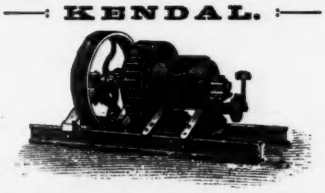

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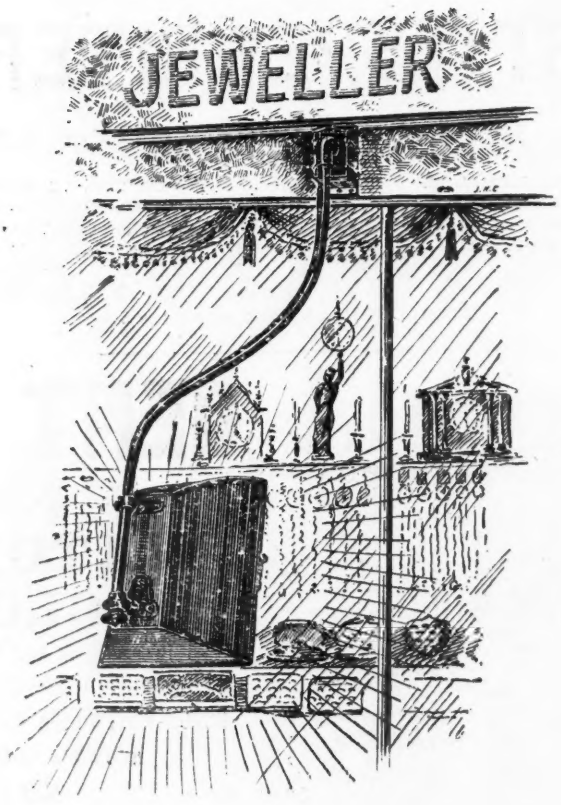

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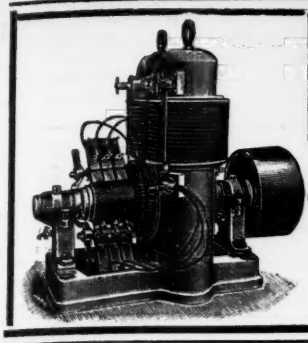

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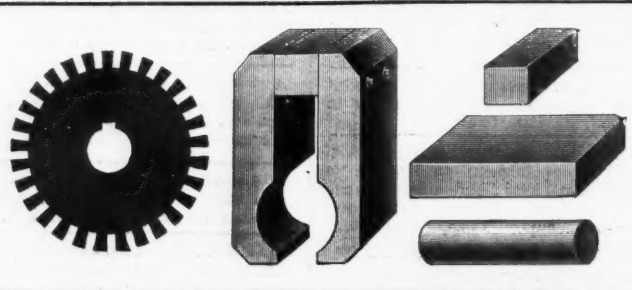

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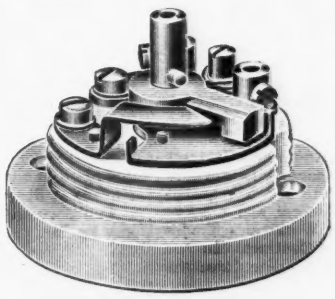

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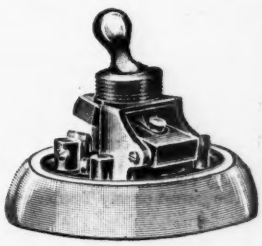

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COURSES IN ENGINEERING SCIENCE.

THE SESSION COMMENCES ON OCTOBER 14th.

NATURAL PHILOSOPHY—Prof. Lord Kelvin, D.C.L., F.R.S., M.Inst.C.E.
GEOLOGY—Prof. John Young, M.D.
CHEMISTRY—Prof. John Ferguson, M.A., LL.D.
MATHEMATICS—Prof. William Jack, M.A., LL.D.
ENGINEERING—Prof. Archibald Barr, D.Sc., M.Inst.C.E.
NAVAL ARCHITECTURE AND MARINE ENGINEERING—Prof. J. Harvard Biles, M.I.N.A.

Prospectuses of the Courses, with regulations for the degrees of B.Sc. and D.Sc. in Engineering Science, and a list of Bursaries and Scholarships open to Science Students, can be had from the ASSISTANT CLERK. 1447

Educational Notices.

THE GLASGOW & WEST OF SCOTLAND TECHNICAL COLLEGE.

THE Diploma of the College is granted in the following Departments of Engineering and other branches of Applied and General Sciences:—

CIVIL ENGINEERING.
MECHANICAL ENGINEERING.
NAVAL ARCHITECTURE.
ELECTRICAL ENGINEERING.
ARCHITECTURE.
CHEMICAL ENGINEERING.
METALLURGY.
MINING ENGINEERING.
AGRICULTURE.
CHEMISTRY.
MATHEMATICS AND PHYSICS.

Special Courses of Study extending over three Academical years have been arranged in each of the above Departments. Average Fee per Session, £14 14s.

Students may enrol in any of the separate Courses of Lectures or in any of the Laboratories, provided they are qualified to take advantage of the instruction given.

The Laboratories for Practical Instruction in Physics, Chemistry, Technical Chemistry, Metallurgy, and Electrical Engineering, and the Engineering Workshop, are liberally equipped with the most approved Apparatus.

Session 1897-98 commences on MONDAY, OCTOBER 4TH. Entrance Examination begins on TUESDAY, SEPTEMBER 28TH.

For Calendar (price 1s. 4d. by post), containing detailed Syllabuses of each Course, particulars of Fees, Scholarships, &c, apply to

38, Bath Street. JOHN YOUNG, B.Sc., *Secretary*.
1479

UNIVERSITY COLLEGE OF NORTH WALES, BANGOR.

ELECTRICAL ENGINEERING.

PROF. ANDREW GRAY, LL.D., F.R.S., will begin in October next a systematic COURSE OF INSTRUCTION in Electrical Measurement and Practical Electricity. The Physical Laboratory is fully equipped with a Compound Steam Engine, Dynamos, Transformer, Secondary Battery, and the most approved modern Measuring Instruments for all branches of Electrical Engineering.

Laboratory Fees at the rate of £1 1s. per Term for six hours per week. Composition Fee for all College Lectures for the Session, £10.

Applications for Calendar, Prospectus, and general information to be made to

J. E. LLOYD, M.A.,
Secretary and Registrar.
1311

Official Notices.

COUNTY BOROUGH OF WEST HAM.

TECHNICAL INSTITUTE AND PUBLIC LIBRARY.

TENDERS FOR WIRING FOR ELECTRIC LIGHTING.

THE COUNCIL are prepared to receive tenders for the Wiring for Electric Lighting of the Technical Institute and Public Library, Romford Road, Stratford, E.

Persons desirous of tendering are requested to send their names to the undersigned not later than September 6th, 1897, together with a deposit of a Bank of England note for £10, which will be returned after the Tenders have been considered by the Council, and provided the Tender is *bonâ fide*, and has not been withdrawn.

To each person making such deposit will be sent a copy of the plans, specification, and form of tender, prepared by Messrs. Gibson and Russell, 11, Gray's Inn Square, London, W.C.

Sealed Tenders to be enclosed in endorsed envelopes supplied with the forms to be delivered to my office not later than noon on the 20th SEPTEMBER, 1897.

The Contractor whose tender is accepted, and with whom a Contract is entered into, will be required to enter into a bond with sureties for the due performance of the Contract, and he will also be required to pay to the whole of his workmen such rates of wages and observe such hours of labour as are recognised by the Workmen's Trades Unions, and in force at the time of signing the Contract. In the event of any breach of such agreement, the Council will enforce the penalty clause.

The lowest or any Tender may not be accepted.

By Order,
FRED. E. HILLEARY,
Town Clerk.

Town Hall, West Ham, E.,
August 24th, 1897.

1403

PERAK GOVERNMENT RAILWAYS.

STRAITS SETTLEMENTS.

TELEGRAPH INSPECTOR required to supervise maintenance of open lines, erect new lines, supervise telegraph offices, repair damage to instruments, &c. Should have theoretical and practical knowledge of telegraphy, and understand location of faults, and setting up of batteries, electric bells, and telephones. Preference will be given to one who has had a course of instruction in one of the large railway telegraph schools, and is acquainted with dynamos and electrical lighting plant. Engagement for 3 years. Salary, $120 per month for the first year, $130 per month for the second, and $140 per month for the third, with option to the Government to renew the engagement for another three years at $150 per month. (The exchange value of the dollar on August 30th was 1s. 9¼d). No compensation for fluctuation or fall in exchange. Free unfurnished quarters will be provided. A contribution of 4 per cent. of salary to be made to Railway Superannuation Fund. Second class passage out and back conditional on good conduct. The selected candidate would have to pass a strict medical examination before appointment.

Applications, stating age, whether married or single, and giving full particulars of experience, and accompanied by copies of testimonials (not originals) with names and addresses of references of whom enquiry can be made as to capabilities and character, will be received by THE CROWN AGENTS FOR THE COLONIES, Downing Street, London, S.W., up to September 21st.

The Crown Agents possess no further particulars respecting the above appointment, and cannot therefore undertake to answer enquiries.

Official Notices.

CITY AND COUNTY OF KINGSTON-UPON-HULL.

ELECTRIC TRAMWAYS.

THE CORPORATION of the above City invite tenders for the electrical equipment of their tramways, to the extent of about nine miles double track and ½ mile single track.

It will be open to contractors to submit tenders for various systems, and the contract, which will not be divided, will include engines and generators, switchboards, feeders, poles, brackets, trolley wire, rail bonding and all accessories, also the first instalment of cars (15 motor cars and 5 trailers).

It is expected that the specification, lithographed plans of the routes and other particulars will be ready for issue early in September, and copies, when ready, may be obtained from the City Engineer, Hull, by persons proposing to tender, upon payment of a deposit of £10, which will be refunded upon receipt of a *bona fide* tender and return of the papers and plans supplied.

Cheques to be made payable to Mr. THOS. G. MILNER, City Treasurer.

Tenders endorsed "Tender for Tramway equipment" are to be addressed to the Chairman of the Works Committee, and delivered at the Town Clerk's Office, Hull, before noon on Friday, November 5th, 1897.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
A. E. WHITE, *City Engineer*,
A. S. BARNARD, *City Electrical Engineer*.

Town Hall, Hull,
August 26th, 1897.

1482

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Manufacturers of

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Great Reductions in Prices!

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1327

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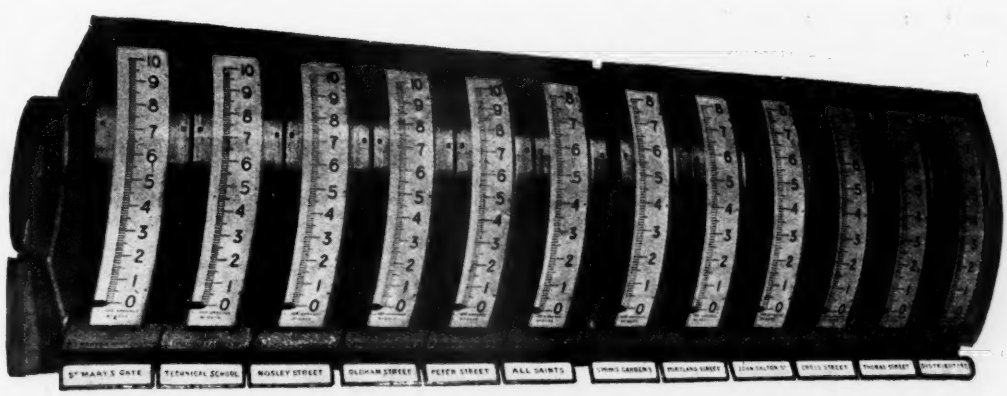

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W. SCOTT, 142, West Regent Street, GLASGOW.

1477

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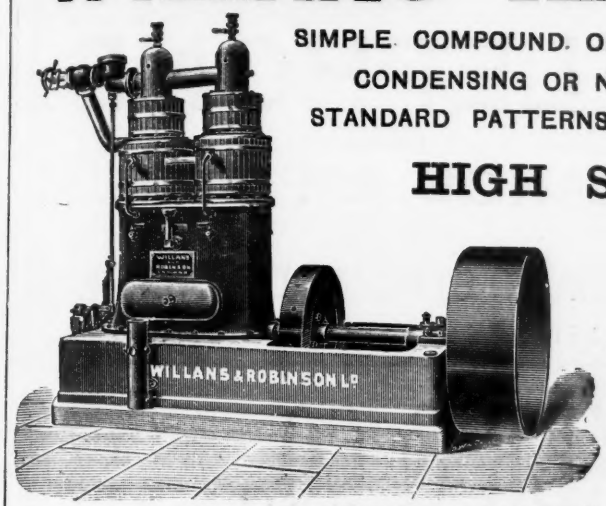
a93

WILLANS CENTRAL VALVE ENGINES



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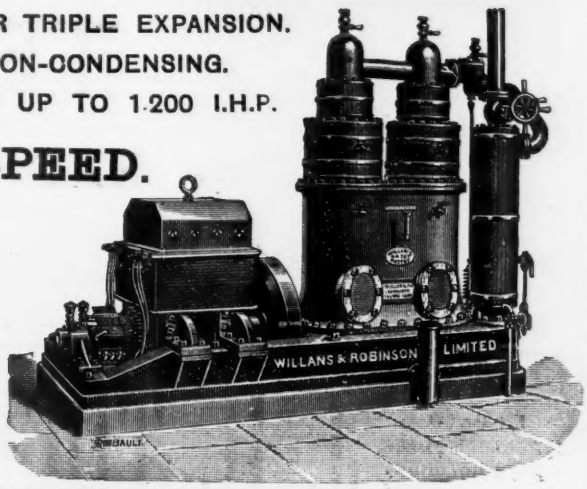

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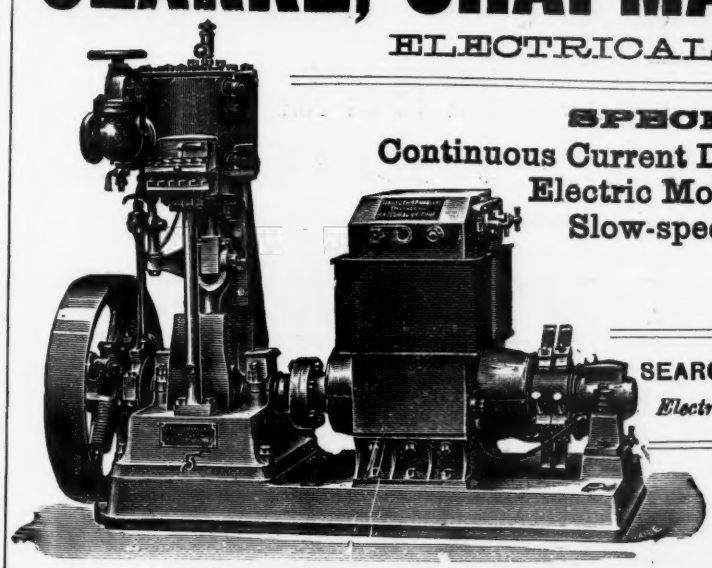

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For Ship Lighting, &c.

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Electric Lighting and Power Transmission.

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Manufacturer of Electrical Wires of every description for Electrical Instruments, Dynamo Machines, Telephones, and Electric Bells.

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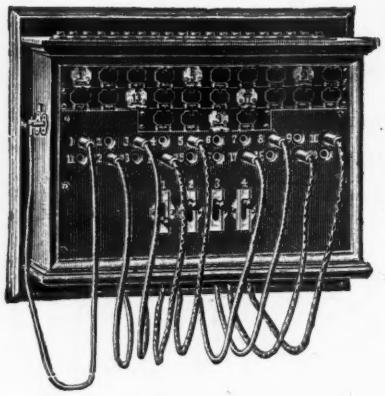
London Agents:—JOHN DAVIS & SON, 118, Newgate Street, E.C. 1144



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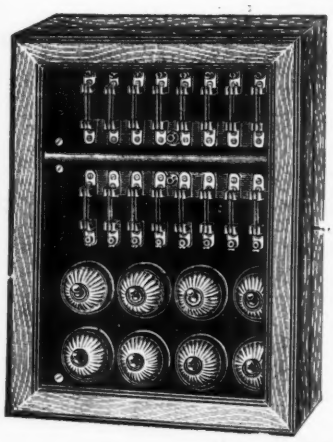

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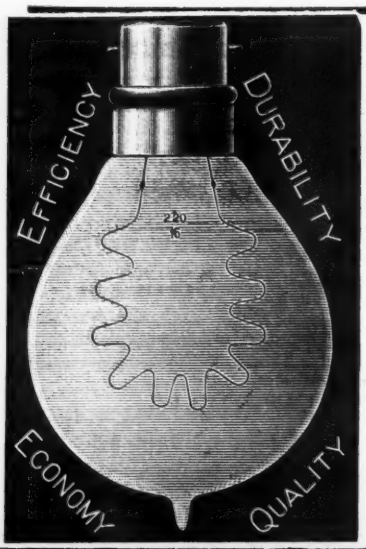

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APPLY TO—

A. & W. HOPKINS,

30, PARLIAMENT ST. **LONDON, S.W.** 1185

This oldest of all telegraph combinations was fortunate in securing the able services of the late Mr. Edwin Clark,* as its first engineer, who was succeeded in this capacity by his brother, Mr. Latimer Clark, and supported by Mr. F. C. Webb, who laid several of these early cables.

Mr. C. F. Varley was at this time the electrician, but later on, for a short period, became engineer as well. Their next engineer was Mr. R. S. Culley, Mr. Latimer Clark now becoming consulting engineer. Mr. W. Hatcher and Mr. Henry Weaver both acted as secretary at different stages. This company's ship, the old *Monarch*, was the first vessel built and arranged for permanent cable work. She was purchased by the Electric Company in 1853 for £6,250, being a wooden paddle-boat of only about 500 tons burden.†

(To be continued.)

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Aug. 31st, 1896	£	s.
Adelaide. Teleg. mat.	75	0
Amsterdam	275	0
Antwerp	70	0
Bombay	242	0
Buenos Ayres	194	0
Calcutta	1,343	0
Cape Town	215	0
Colombo...	52	0
Durban	45	0
East London	41	0
Flushing	31	0
Fremantle	16	0
Hong-Kong	30	0
Madras. Teleg. mat. ...	77	0
Melbourne	100	0
„ Teleg. mat.	843	0
Passages	11	0
Port Elizabeth	581	0
Rockhampton	56	0
Rotterdam	44	0
Singapore	164	0
Sydney	366	0
Townsville	5	0
Wellington	91	0
Yokohama	78	0
Total	£5,045	0

Week Ending Aug. 31st, 1897.	£	s.
Adelaide	7	0
Amsterdam	90	0
„ Teleg. mat.	64	0
Antwerp	62	0
Beira	1,032	0
Bombay	407	0
„ Teleg. mat. ...	68	0
Boulogne	159	0
Buenos Ayres	100	0
„ Teleg. mat. ...	34	0
Calcutta...	205	0
Canterbury	9	0
Cape Town	119	0
Clinde	1,060	0
Durban	656	0
East London	409	0
Flushing	80	0
Fremantle	272	0
Hamburg	275	0
Madras	11	0
Malaga	243	0
Melbourne	307	0
Nelson	61	0
Otago	135	0
Perth	112	0
Port Chalmers	634	0
Port Elizabeth	99	0
Rangoon	9	0
Rockhampton	15	0
Rotterdam	84	0
Shanghai	91	0
„ Teleg. mat.	24	0
Singapore	21	0
Stockholm	59	0
Wellington	76	0
Yokohama	56	0
Total	£10,493	0

Foreign Goods Transhipped.

	£	s.
Launceston	21	0

Bankruptcy Proceedings.—The first meeting in the failure of Geo. Thompson (G. Thompson & Co.), electrical engineer, of 115, Queen's Road, Brighton, is to be held at the Official Receiver's office, 4, Pavilion Buildings, Brighton, on September 3rd (to-day), at 12 o'clock noon. The public examination is announced for September 23rd, at 11 a.m., at Court House, Church Street, Brighton.

Dissolution of Partnership.—Messrs. W. F. Simpson and J. F. Simpson, carrying on business as electrical engineers and contractors at Hapton, near Burnley, Lancs., under the style of Simpson Bros., have dissolved partnership by mutual consent as from June 30th. Debts will be attended to by W. F. Simpson, who will continue the business under the old style on his own account.

First Meetings.—The first meeting of creditors in *re* The Epstein Electric Accumulator Company, Limited, will be held at 33, Carey Street, London, W.C., on September 10th, at 11 a.m. The first meeting of contributories will be held at the same place at 12 noon on the same day.

Liquidation Notice.—At meetings of the Max Saturn Electrical Syndicate, held on August 9th and 24th, resolutions were passed winding up voluntarily, and appointing Mr. W. S. Mackenzie, of Silverleigh, Constantine Road, Hampstead, liquidator. Creditors are required to send information of their debts or claims, and the usual information, to the liquidator, on or before October 14th.

Crompton & Co.—This company announce that as they have had no agent in South Wales for some considerable time past, they have opened a branch office at Western Mail Chambers, Cardiff, where Mr. W. W. Hughes will act as manager of the branch directly representing the company under control of the head London office. Messrs. Crompton & Co., Limited, have now completed the erection of their new works at Chelmsford, and as these are being equipped throughout with most modern machinery and appliances, they claim that they will be enabled to manufacture electrical machinery and appliances both economically and quickly. The firm have obtained the order for the supply and erection of plant and mains for the lighting of the town of Maerdy Glan.

Factory Extensions.—The *City Press* says that a new factory is about to be built at Brook Green, Hammersmith, for the Incandescent Electric Lamp Company, at a cost of about £7,000.

List.—Messrs. J. C. Lyell & Co. send us their latest illustrated price list of electrical accessories, oil filters, carbons, lamps, &c. These accessories are stated to be all English make, and are mostly mounted on Buller's porcelain. A special feature is made of oil filters, which will be found of great utility on private installations, as they are stated to effect great economy, and repay the first cost in six months. No extraneous substances or chemicals are used, and there is nothing to wear out or deteriorate.

New Electrical Business.—The new Limited Liability Company who have taken over the engineering business carried on for many years by Mr. J. W. Brooke at the Adrian Ironworks, Lowestoft, will make electrical engineering a speciality, and will open offices and showrooms in London.

Shortness of Water in a Boiler.—For the purpose of preventing boiler explosions occurring through lowness of water, Messrs. A. D. Studd & Co., of Kettering, are placing upon the market Brown's patent electric low-water alarm. The likelihood of explosions happening, perhaps accompanied by fatalities, dangerous collapsed flues, burning out of furnace crowns, &c., overheating effects on the boiler often rupturing it throughout as the result of shortness of water, renders it necessary that some such apparatus should be employed. The construction of Brown's electric alarm is as follows:—A mercury tube, similar to a thermometer tube, is encased in a metal fitting, which is attached to the boiler front by a pipe and elbow inserted at low water level, or through the crown of shell (as in a marine type); two platinum wire ends are inserted in the sides of the mercury tube above the normal position of the mercury, one of which is attached to the fitting, thus forming the earth part of circuit, and the other to the insulated binding screw at the top; there is therefore only one wire to the bell and battery. So long as the water in the boiler is above the low water level, it is forced up into the pipe and body of fitting; the temperature, by the cooling action of the atmosphere quickly falls below boiling point, thereby keeping the mercury below the wire ends; but should the water fall below the low water line, the water (by its gravity) falls back again out of the pipe and fitting, which is then instantaneously filled with steam, the higher temperature of which causes the mercury to rise above the two wire ends, thus making a mercurial connection between them, completing the electric circuit and causing the alarm bell to ring; upon the water being replaced, the mercury falls again to its normal position, thus breaking the circuit, and the bell stops ringing.

ELECTRIC LIGHTING NOTES.

Bexhill.—The District Council is purchasing a site, half an acre in extent, for £500, for electric lighting works.

Bloemfontein.—We understand that tenders have been accepted for providing and erecting a complete electric lighting installation for Bloemfontein.

Brighouse.—A committee has been appointed by the Town Council to inquire into the question of refuse destruction with a view to utilising the steam power therefrom for electric lighting purposes.

Briton Ferry.—Messrs. Herbert Lewis & Fletcher are putting down a complete electric light and power plant at the Cape Copper Company's Works, Briton Ferry, the total capacity of which is equivalent to 900 8-C.P. incandescent lamps. Arc lamps are to be used for outside lighting, such as sidings, yards, &c., while the buildings are lighted with both arc and incandescent lamps. High voltage lamps are to be used.

* Previously superintending engineer of the Britannia Tubular Bridge under Robert Stephenson.

† The old *Monarch* laid the first Anglo-Dutch cable of 1853. She was, in fact, bought by the then newly-formed International Telegraph Company and fitted out as a telegraph ship, especially with a view to this (her first cable) expedition. In the night, during the laying of the above cable, a north-east gale nearly carried away her funnel, and she rolled so heavily in a beam sea that the engineer had to be lashed near the brake which controlled the egress of the cable. Mr. Latimer Clark, the electrician, lying on a sofa in the saloon, sent the signals every 15 minutes (to signify continuity of the line) by tugging a string tied to a single-needle instrument. It need scarcely be remarked that the methods of paying out a cable and of testing it the while have been greatly improved since those days.

Cardiff.—At the last meeting of the Union Building Committee, correspondence was read as having taken place between the Town Clerk, Mr. Applebee, electrical engineer, and the clerk to the Guardians, with reference to a supply of electricity to the Workhouse, and Mr. Seward having submitted a report as to the cost of electricity in comparison with gas, and also as to the cost of fittings, "the chairman thought they should ascertain the difference in the temperatures of both, and it was decided to ask the architect (Mr. Seward) to report on the heating of the rooms."

Cirencester.—The District Council has received notice from an electricity supply company of its intention to apply for a provisional order for lighting the district. The matter is in the hands of a committee.

Colwyn Bay.—Preparations are on foot for the lighting of the new promenade with electric light, Mr. R. Peers having been entrusted with the work. There will be eight arc lamps, each 1,000 C.P., on the sea front.

Dingwall.—Last week the Town Council sitting as Electric Lighting Committee at an adjourned meeting resolved upon the electric lighting scheme submitted by Mr. R. F. Yorke. The matter has yet to come before the Council.

Doncaster.—The Corporation in Committee has recommended that Mr. Shoolbred be appointed to advise the Corporation for a preliminary report prior to an application for a provisional order for electric lighting.

Dover.—The Burlington Hotel has now been opened for the reception of visitors. This hotel, which is the largest in the town, has been fitted up for the electric light by Mr. Leo Sunderland, agent for the Brush Electrical Engineering Company, the installation consisting of an equivalent of 2,500 8-C.P lamps, in addition to a number of fans for ventilating the kitchens, serveries and dining rooms, which is a welcome addition to the supply company's list of consumers.

Edinburgh.—Since the Court rose for the summer vacation, Messrs. William Bryden & Sons have been engaged wiring the hall and various court rooms, judges' rooms, entrance hall, enrolling room, and other places for the introduction of the electric light from the Corporation mains. The hall will be lighted by 48 32-C.P. lamps, suspended at regular intervals from the ornaments of the oak-vaulted roof. In the entrance hall there will be 12 lights of 32-C.P. each; in the divisions six lamps will be placed; each of the outer house bars will be adequately lighted, as well as the Justiciary Court and New Court room. The circuits will be distributed from two main D.P. distribution fuse boxes. It is expected that the work will be completed before the Court sits in October.

Gloucester.—The Corporation, at their meeting on Tuesday, had under consideration a report prepared by Mr. Robert Hammond for a proposed electricity supply and dust destructor works for the city. It is estimated that the scheme will involve an expenditure of between £40,000 and £50,000, and it was decided at the meeting to establish electric supply works with dust destructor in connection therewith, and to apply to the Local Government Board for sanction to borrow the necessary money for the purpose. In view of the compact nature of the city, Mr. Hammond recommends the adoption of low pressure continuous current feeders, with the three-wire method of distribution, at a pressure between the outer conductors of 440 volts. The sectional area of cables estimated for could support a maximum load of 30,000 lights. For high-speed plant, the estimated cost of generating works, with engines and dynamos, of total capacity of 300 kilowatts (two 150-kilowatt dynamos) capable of supplying 7,500 lights (with accumulators 11,250) fixed on consumers' premises, works out as follows:—Buildings, £7,200; boiler house plant (including two 30 feet × 8 feet Lancashire boilers with mechanical stokers), £1,500; engine house plant, £5,650; miscellaneous, £1,250; total, £15,600. The alternative estimate for the same capacity of plant, but with slow-speed engines, comes to £18,150. The estimated cost of equipment of generating works with engines and dynamos of total capacity of 450 kilowatts would be—high speed plant £16,670, slow speed plant £19,920. A two-cell dust destructor, with all necessary brick buildings, tipping platform, suitable for dealing with 30 tons per diem, inclined roadway, 150 feet by 4 feet, chimney and water tube boiler, is estimated to cost £6,000; but if the destructor were combined with the electricity supply works, there would be an appreciable saving in capital outlay in the direction of the chimney, which is valued at £1,200, as a slight increase in the size of the electricity works chimney would make it serviceable for both purposes. The Council decided to engage Mr. Hammond to prepare a scheme for establishing an electricity supply and dust destructor for Gloucester on the lines suggested in his report, and afterwards to prepare plans and specifications for, and superintend the carrying out of such work, Mr. Hammond to be paid a fee of 5 per cent. upon the actual outlay in respect of the buildings, engines and plant for the electric supply work, and a fee of 150 guineas in respect of the dust destructor works. A sub-committee of the Council was appointed to visit several towns that had adopted the electric light, and report.

Gorton.—A special committee has been appointed by the District Council to inquire into the desirability of calling in an expert electrical engineer to advise on the question of electric lighting.

Greenock.—A meeting of the Finance Committee of the Town Council was held on the 24th ult. to consider the report by the sub-committee on the electric lighting of Greenock, Port Glasgow, and Gourock, which recommended that a joint sub-committee, along with the town clerks of the respective burghs, be appointed to obtain full information for the guidance of the respective boards, with power to visit any of the towns in Scotland where an electric light installation has been provided, and to employ an electrical engineer to visit the three burghs, and advise as to the best means of utilising the motive powers available for generating a supply of electricity, &c. After a prolonged discussion it was agreed to remit the whole matter back to the sub-committee again, to report as to what towns, having control of the gas works, have an electric light installation also, and what is the relative cost of gas and electric light, what amount the sub-committee propose spending on visits to other towns, engineer's report, &c., and how they propose to allocate the cost.

India.—An Indian paper says that the apparatus for lighting the Arkonam Junction station with electricity will shortly be received from England. The agent and manager of the Madras Railway has submitted to Government an estimate for Rs. 6,200 to construct a power house for the engines and other works. The cost of the whole project amounts to Rs. 17,230, which the Government has sanctioned.

Leeds.—The Markets Committee has decided that the open space at the Kirkgate Market, which is now being covered in, the alleys, and the old fish market, shall be lighted by means of electricity. For this purpose the Committee will ask the Council to vote £2,000.

The Liberal party are bringing weight to bear upon the Council in regard to the electric lighting question. They consider the Council should purchase the undertaking of the Yorkshire House-to-House Electricity Company at once.

Leith.—The applications for the post of electrical engineer to the Corporation were to come before the Electric Lighting Committee last week, but a quorum of members could not be secured.

Liverpool.—The Finance Committee proposes to issue a new Liverpool Corporation stock to cover the cost of the electric light purchase, the acquisition of the tramways, the introduction of electric trams, and other works.

London.—The Strand Guardians have resolved to refer the subject of lighting the offices with electric light to a special committee, with instructions to report.

Motherwell.—The Electric Lighting Committee have resolved to recommend to the Town Council that an installation of electric light be laid down for the purpose of illuminating the streets of the burgh. The provisional order obtained by the Commissioners lapses in nine months. It is proposed at present to illuminate the central portion of the town, but no definite system has yet been adopted.

Perth.—Mr. Barton, of Blackburn, was present last week at a meeting of the Committee recently appointed by the Town Council in connection with the introduction of electric light in Perth, and gave information on the subject.

Reading.—The Reading Electric Supply Company notify that from September 1st they will give a continuous supply of electric current from their central station in the Vastern Road.

Rotherham.—A special meeting of the Rotherham Town Council was called for Wednesday, to consider the advisability of applying to the Board of Trade for a provisional order.

Salford.—At a meeting of the Town Council on Wednesday amongst other matters considered were resolutions of the Electric Light Committee, recommending the Council to apply to the Local Government Board for authority to borrow the sum of £10,000 for providing a battery sub-station for the Regent Road district, and the requisite cables, and also to borrow the sum of £80,000 to cover the cost of land, buildings, and machinery, to extend the electric light undertaking, and adopt resolutions thereon.

Salisbury.—Messrs. Edmundsons, Limited, will put into hand at once the works for an electric supply at Salisbury, at which place they propose to acquire the Town Mills for a central station. An agreement has been entered into that the work necessary to ensure the lighting of the city by electricity shall be completed by the end of March next. Water will be used as a main motor, the amount available at the Town Mills being about 25 horse-power in summer and double in winter.

Sheffield.—On 29th ult. the Parish Church was lighted by electricity for the first time. The gas brackets have been altered, and are now used for the electric lighting.

Sheffield Parish Church is now lit by electricity. The cost of the installation has been £350.

Torquay.—The Corporation will utilise its electric lighting installation for lighting the Town Hall and Bath Saloons. The Victoria and Albert Hotel is already partly equipped, and others are following suit. The light is to be introduced at the Primitive Methodist Chapel at Ellacombe.

Wakefield.—The reason assigned for the delay in opening the electric lighting works is that the men in the employ of Messrs. Fowler & Co., of Leeds, the contractors for the engines, are locked out.

Winchester.—It is stated that the contract for the electric lighting station buildings has been secured by Mr. J. Thomson, of Peterborough.

Wolverhampton. — The Springfields Horticultural Society held their annual exhibition in Wolverhampton last week, and a new feature was the lighting of the tents and field by electricity. The electricity was generously supplied by Messrs. Thomas Parker, Limited, electrical engineers, whose works are situated only a short distance from the show ground.

A slight accident occurred about 8 o'clock on Wednesday evening at the Wolverhampton Electrical Generating Station, Commercial Road, the result of which was to throw out of action both the dynamos then running. As a consequence, the street lamps were extinguished for about half an hour; but the lighting of shops, and private lighting generally, was only partially affected, so that little inconvenience was caused.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

British Engineers to Introduce Electric Traction into Spain.—It is interesting to note, says the September number of the *Railway World*, that while the Corporation of Liverpool has been advised that it is necessary to obtain an engineer from America in order to construct some four miles of electric tramway, a British firm has been given the contract for the electrical equipment of extensive tramway systems in Madrid and Barcelona. The total amount of the contract, including 160 motor equipments, is, we believe, about £160,000, which makes it the largest contract for the construction of electric tramways that has been signed in Europe, and with one exception it is, we believe, larger than any single contract made in America. This should make it clear to Corporations or companies contemplating the construction of electric tramways, that British firms and engineers are perfectly competent to construct any system of electric tramways that may be required. We may add that the contractors for the Spanish lines referred to are Messrs. Dick, Kerr and Company, Limited.

Douglas Cable Tramways.—The cable of the Douglas upper town tramway having stranded several times during the past few weeks, a new cable has been put in. The discarded cable was put in at the latter end of August last year.

Electric Tramways in Egypt. — Mr. Killingworth Hedges writes to the *Times* as follows: "My recent experience enables me to state that the Ministry of Public Works particularly wish to obtain offers for the concession for the supply of electricity to Cairo from English firms. I was instructed to draw up a *cahier des charges* in French, the official language of the department, but an English translation is appended, and as the electrical technical terms are similar for both languages in this case your correspondent's remarks as to the difficulty "by our non-metrical system of weights and measures and money" would hardly apply. Electricity is being largely employed for traction as well as for lighting in Egypt, but the electrical tramways of Cairo have been constructed by a Belgian company, who obtained the concession by working in conjunction with a large German firm of electrical engineers. The English contractors probably did not hear that the concession was on offer until it was too late, for they only send a representative occasionally, while their foreign trade rivals have some one in authority on the spot, who, if not an engineer, is able to obtain the best technical advice and send information to headquarters at once. Another, and perhaps more important reason is that specifications of any important work are, I believe, sent to the chambers of commerce in the principal European capitals, and copies are distributed to the manufacturing towns and placed where they can be seen by contractors. I do not think, with perhaps the exception of the Foreign Office, that there is any place in England where these documents would be received and laid out for inspection, for it appears that the Egyptian Government, unlike the colonies, have no agent from whom contractors can obtain information about engineering works which are not included in the railway administration."

Glasgow.—The Tramways Committee have drawn out a scheme which they recommend for the extension of the tramways. It is stated that the Corporation have the necessary powers under their 1893 Act, and as these powers lapse in August next the committee propose the extensions. We should think, however, that it would be unwise to decide what method of traction to adopt until the Glasgow Corporation have ascertained how the trolley system works upon the experimental line to Springburn. We, ourselves, have no doubt about its ultimate success, therefore we think it would be a pity to adopt any other form of mechanical power, or horse-power, for the new lines at present.

Motor Car Mishap.—A motor car returning from Southport to Liverpool, with a local musician and driver on board, was going at a high rate of speed when it was turned to avoid some loose metal on the road, and struck a tree, breaking the musician's leg and causing other injuries.

Motor Dust Carts.—The Chiswick Urban District Council leads the way in the use of motor carts for dust collection. Mr. Ramsden, the surveyor to the Council, reports that a week's experience with one of the carts shows that they are very easily controlled, and far more economical than horse labour. The steam wagon does the work of three ordinary carts, and Mr. Ramsden estimates that the Council will save between £500 and £600 a year by the adoption of the new system.

Sheffield.—We gather from some remarks in a Sheffield paper that the Tramways Committee which has been going exhaustively into the need for tramway extensions in that city, has come to the conclusion that various districts beyond those already recommended, should be provided with tramways. It is held that some of these lines would immediately command good revenues.

The Jungfrau Railway. — The construction of the railway to the Jungfrau has been actively pushed forward since the beginning of the season. A *Financial News* correspondent says that over 150 Italians are employed for boring a small tunnel which is to run beneath the glaciers of the Eiger, and it is expected that the part running under the glacier will be completed by the beginning of September of this year. The electric works at Lauterbrunnen are ready to supply the motive power for the work on the great tunnel, and the possibility of continuing the work during the winter is now under consideration. Should this be decided upon the company will be obliged to make special arrangements and to bear extra expenses to ensure the keeping of the workmen, who will have to carry out an unprecedented labour under all the disadvantages of a harsh climate.

York.—At the half yearly meeting of the City of York Tramways Company, held on Tuesday at the Station Hotel, York, the Chairman said that the provisional order authorising the use of electric traction had been confirmed by Parliament, and the company was in a position of being able to make an arrangement for using electric power on the tramways when it was provided for the lighting of the city. At present the Corporation had the power to light the city by electricity. In fact they had had the power for a considerable time, but nothing had yet been done. However, it was the ordinary practice that if any corporation did not carry out an order, powers were given to other people to do so, and in this case the Corporation of York would either carry out the order themselves or make an arrangement with someone else to use electricity for the lighting of a portion of the streets. When that undertaking had been carried out the Tramways Company would be in a position to become one of the largest consumers of their electricity for the purposes of traction. Unless they had gone to Parliament to get the power to use electricity they would not be in that position, and it was better both for the company and the Corporation that they should possess it. The directors were satisfied that they did the proper thing in going for the order. He was sorry to say that the negotiations with the local authorities had been considerable in consequence of their opposing the company getting that order. It was only with the greatest difficulty that the company carried to a successful issue the negotiations with the Board of Trade, which enabled them to get the order in its present form.

TELEGRAPH AND TELEPHONE NOTES.

African Trans-Continental Telegraphs. — The Johannesburg correspondent of the *Financial Times* says that the trans-Continental telegraph line from Rhodesia north seems to be in need of all the repairing Dr. Jameson is reported to be about to give it. Captain van Niekerk has reported to Salisbury from Mount Darwin, under date June 26th, as follows, regarding his recent march up with a small force:—"The telegraph line, as far as we can judge (for we did not continue patrolling the line in the hills after being fired on), is stripped from Simoona to Darwin; almost all the wire has been removed, insulators broken, and in many cases the tops have been removed and the bases broken. With regard to convoys from Salisbury, I consider that the road is not safe, and that at least 25 men would be required as an escort to any wagons that may be sent up. Should work be started on the telegraph line, I consider that two forts should be erected and garrisoned between this and the pass, where the road enters the hills, a strong one being placed closed to Tamaringa's. I have endeavoured to get into communication with the natives, and on one occasion had an indaba, but without success. There seems to be a number of natives scattered about throughout the district. Some have been seen as close as one mile and a half from our camp, and in my opinion it is not safe for single men, even if armed, to go far from the fort."

Foreign Telegraph Money-Orders. — The following communication has been received by Mr. Henniker Heaton from the Postmaster-General:—"Negotiations are in progress with the German Post Office for the establishment of a system of telegraph money orders between the two countries, and when the conditions have been agreed upon, it is intended to propose a similar arrangement to other foreign countries and to British Colonies."

The French-American Cable.—A Paris dispatch dated 26th ult., says that about 1,700 miles of the new French cable which is to connect France with the United States has been laid at the American end. Operations are now about to be commenced from Brest, and it is believed that the work will be completed and the cable ready for use by the end of September.

The Glasgow Telephone Inquiry.—Messrs. Wright, Johnston, Mackenzie, and Roxburgh, who have been instructed by a number of subscribers to attend the public inquiry by Sheriff Jameson regarding the telephone service, have issued a circular requesting information for their guidance in the conduct of the investigation. "As this inquiry," the circular says, "will in all probability settle the position of subscribers for many years to come, both as regards the sufficiency of the service and the charges made therefore, it is most essential that full particulars of the past experience of the subscribers as to the working of the telephones

should be laid before the Court." Among the queries to be answered in an accompanying schedule are the following:—"Have you within the last three years made complaints to the Telephone Company in regard to the efficiency of the service? State the grounds of the complaints—(*a*) Delay in giving connection; (*b*) in distinctness; (*c*) ringing off before conversation is finished; (*d*) failure to get connection on the ground that other subscribers were engaged. Have your complaints been attended to? Do you consider the annual charges reasonable? If the annual charges for the instruments were lower would you use more instruments than at present, and would such be beneficial to your business or convenience?" The inquiry will be opened on Monday, September 27th, in the Burgh Court Hall.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Cayenne-Pinheiro (Brazil)	July 22nd, 1897 ...	Aug. 30th, 1897.
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Zanzibar-Mombassa ...	... July 13th, 1897 ...	Aug. 31st, 1897.
Cyprus-Latakia ...	... July 23rd, 1897 ...	...
Aden-Zanzibar ...	... July 28th, 1897 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Siberian landlines—		
Tschita-Kaidalowo (all lines).	Aug. 9th, 1897 ...	Aug 30th, 1897.

April 19th, 1897.—During war between Turkey and Greece, cable between Trieste and Corfu cannot be used for messages for Turkey; they must be sent *vid* Bosnia, Montenegro and Servia.

The Ottoman Government announces that messages in secret language may not be sent to the Greek Minister and Consul in Turkey. They are to be sent in plain language.

April 21st, 1897.—The Greek Administration prohibits secret language for private telegrams for Greece.

April 25th, 1897.—The Hellenic Administration notifies delay on press messages emanating from Greek provinces by reason of the lines being blocked.

April 26th, 1897.—The Ottoman Administration notifies that, until further notice, private telegrams for Crete must be written only in plain Turkish or French language.

August 5th.—Eastern Company announce owing to interruption of East Coast route, messages for South Africa are subject to serious delay.

August 7th.—Communication with South and East Africa temporarily interrupted by both routes.

August 10th.—Eastern Company announce that traffic for South and East Africa is still subject to serious delay.

August 27th, 1897.—A telegraph line has been constructed in the Island of Madagascar, and will be opened to international service. The line starts from Majunga and the following new offices are now open: Andevorcate, Ankeramadinaka, Beferona. Macoetanama, Mapatsara, Marovoay, Moramanga, Ribaankayobe, Tamatave, Tananavive. The rates for the offices are the same as for Majunga.

The River Plate Telegraph Dispute.—The *Financial Times* says in Wednesday's issue:—"In a recent leading article we commented upon the most unfair treatment which had been meted out to the River Plate Telegraph Company and the British corporation by the Argentine Government. On the same day the matter was brought to the attention of the British Government in the House of Commons. Mr. Curzon, in replying, stated that representations had already been made by the British Minister to the Argentine Government. A day or two afterwards the Chargé d'Affaires at Buenos Ayres, in the absence of the British Minister, called on the Argentine Minister of Foreign Affairs and again directed his attention to a note passed to him by Lord Salisbury suggesting that the Company should be allowed to open its lines to all classes of traffic other than that in dispute. As a result of this we are glad to learn a conference was held with the Company's representatives on August 7th last and an agreement reached in consonance with Lord Salisbury's suggestion, without prejudice to the Company's rights or any suit it might institute to maintain them. We have as yet, however, not learned that Congress has given permission for a suit to be brought against the Government, and as the principle involved is an important one, we hope the Company will see its way clear to push the matter.

CONTRACTS OPEN.

OPEN.

Dumfermline.—Offers are wanted for fitting up the electric light at Muirbeath Colliery, Dunfermline.

France.—September 7th. The French Post and Telegraph Authorities are inviting tenders for the supply of 40 tons of homogeneous iron wire, 2½ mm. in diameter, 80 tons of ordinary iron wire 7 mm. in diameter, 10 kilometres run of iron pipes 65 mm. diameter for pneumatic lines, and 200 kilometres of submarine telegraph cable. Tenders to the Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Hull.—November 5th. The Corporation invite tenders for the electrical equipment of their tramways, to the extent of about 9 miles double track and ½ mile single track. The contract will not be divided and will include engines and generators, switchboards, feeders, poles, brackets, trolley wire, rail bonding and all accessories, also the first instalment of cars (15 motor cars and 5 trailers). Further information can be obtained from our "Official Notices." City engineer, Mr. A. E. White. City electrical engineer, Mr. A. S. Barnard.

Llandudno.—September 22nd. The District Council wants tenders for certain works in connection with the electric light and dust destructor scheme, including the supply of water tube boilers, condensing plant, &c., steam engines and dynamos, switchboard, battery, travelling crane, underground mains, arc lamps, posts, &c. Particulars from Mr. A. H. Preece, 39, Victoria Street, Westminster.

Port Elizabeth.—September 21st. The Town Council invite tenders for lighting the streets and municipal buildings of Port Elizabeth by electricity in consideration of the grant of a concession for the exclusive right of supplying electric current through the streets and roads of the town to private houses, stores, &c., for terms of 5, 15, 20, 25 or 30 years respectively.

Roumania.—November 15th. Tenders are being invited by the Municipal Authorities of Ploesti, for the concession for the establishment and working of an electricity generating station in the town, during a period of 40 years for private and public lighting and also for power transmission purposes.

Russia.—September 30th. Tenders are being invited by the Municipal Authorities of Penza for the concession for the construction and working of a system of tramways in the town to be worked either by electricity or other mechanical power.

Russia.—November 1st. The Municipal Authorities of Novorossisk, South Russia, are inviting tenders for the concession for the construction and working of an electric tramway and for the electric lighting of the town.

Sofia.—September 22nd. The Secretary of State for Foreign Affairs has received a despatch from the Acting British Consul-General at Sofia, stating that the municipality of that town invite tenders for—(1) The supply of electric current to light the streets as well as public and private buildings in the town and the supply of electric power; and (2) The construction and working of electric tramways in the town and suburbs. Tenders will be received at the offices of the municipality of Sofia. Such further particulars as have been received may be seen at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

Spain.—The Municipal Authorities of Almodovar del Campo (Cuidad Real province) are at present inviting tenders for the concession for the electric lighting of the public streets of the town. Tenders to, and particulars from, El Secretario del Ayuntamiento de Almadovar del Campo (Cuidad Real).

Switzerland.—September 25th. Tenders are being invited by the Municipal Authorities of Lausanne for the concession for the establishment and working of a central electricity supply station in the town. Tenders to be sent to, and particulars may be obtained from, Le Conseil Municipal de Lausanne.

West Ham.—September 20th. The Council wants tenders for the wiring for electric lighting of the Technical Institute and Public Library at Romford Road, Stratford, E.

Whittingham, (Lancs.).—September 20th. Tenders are invited for electric lighting and plant required at the new hospital and reception wards at the County Asylum, Whittingham, for the Lancashire Asylums Board. Particulars at the offices of Messrs. Simpson and Duckworth, architects, Richmond Chambers, Blackburn, or at the offices of the consulting engineers, Messrs. Fawcus and Clirehugh, Temple Chambers, Brazennose Street, Manchester.

Obituary.—The death occurred on 29th ult., at his residence at Leeds, of Mr. J. C. Chambers, formerly postal telegraph superintending engineer of the north-eastern district. Mr. Chambers, who was 66 years of age, retired from the Telegraph Service in June, 1896, after a connection extending over a period of 44 years. He joined the British Electric Telegraph Company upon its formation in 1852, being then stationed at Stockton. The telegraphs were transferred to the State in 1870, and eight years later, on the re-arrangement of the divisional engineers' headquarters, Mr. Chambers was appointed to the position which he held at the time of his retirement.

The death has taken place of Mr. William Morgan, of Brentwood, at the age of 63. The deceased was for 35 years an engineer in the Telegraph Department of the General Post Office, and was in the employment of the old Electric Telegraph Service, before the Government became the owners of the telegraph. About three years ago he commenced business at Brentwood as an electrical engineer.

NOTES.

"Electrical Review" Offices.—Advertisers, contributors, and all readers and friends of the Electrical Review and the "Universal Electrical Directory," will please observe that on and after September 6th, the offices of these publications will be removed to No. 4, Ludgate Hill, E.C. (two doors from St. Paul's Churchyard), to which address all communications should be sent.

Dover Corporation Electric Trams.—On Friday morning Sir F. Marindin, R.E., and Major Cardew, R.E., visited Dover for the purpose of making their official inspection of the Corporation electric trams. One of the cars, with a trailer attached, awaited the arrival of the inspectors at the station. As soon as they arrived they got on to the car, accompanied by Mr. H. E. Stilgoe, borough surveyor; Mr. S. Sellon, consulting engineer; Mr. C. W. Bagshawe, chairman of the Electricity Supply Company, besides several members of the Town Council and other prominent local personages. The system adopted is the overhead trolley.

The trials went off most satisfactorily, the route from the Pier to Buckland being traversed without a hitch. The Corporation have very wisely decided to make the fares 1d. any distance, a step which has met with general approval in the town. It has not been definitely decided yet when to commence the service, but it will probably be at the end of next week. The photo shows the car with the officials on board passing up Biggin Street.

Wireless Telegraphy.—According to yesterday's daily papers:—"A large quantity of instruments, weighing in all about two tons, arrived at Dover on Wednesday in connection with some experiments in wireless telegraphy which are to take place there. The arrangements include experiments from Fort Burgoyne to the north of Dover Castle, and other parts of the surrounding country, which offers facilities for work of this character, on account of the prominent positions it affords. From the success which has attended the experiments elsewhere, it is believed the system can be successfully applied to lightships. It is stated at Dover that the Goodwin light vessels will be experimented with, under the direction of Mr. W. H. Preece."

Engineering Classes.—We have received a copy of the syllabus of lectures to be delivered in the Engineering Department of the City of London College, Moorfields, during the 1897-98 session. The department is in the hands of Mr. Henry Adams, M.I.C.E., M.I.M.E., &c., and competent assistants. Copies of this pamphlet can be obtained from Mr. David Savage, secretary, at the College.

The Cabdrivers' Protest.—The cabdrivers have met and have passed their verdict upon the electric cab. Of course it would be un-English to submit without a struggle, but we do not know that there is much need for immediate fear on the cabby's part. If the change does take a firm hold, it will be more or less gradual, and what the cabby must do is to prepare himself for the new order of things. He must not think that by abstaining from driving electric cabs he will set the new industry back, for there are heaps of good men ready for the work. A full meeting of the Executive Committee of the London Cab Trade Council was held on Friday, when the question of electrical cabs and their probable effect upon the cab trade of the metropolis was discussed. Mr. Fred White (general secretary) stated that the introduction of electrical cabs in London should engage the serious attention of all cabdrivers. In the eager rush to drive these new vehicles, cabdrivers should bear in mind that the slightest demand would inevitably tend to increase the price of cabs, as was the case when noiseless tyres and improved hansoms were first put on the streets by Earl Shrewsbury and Lord Savernake. At the present moment the price of a cab had reached the maximum, and it was impossible for cabdrivers to bear any further burden in the shape of enhanced prices, as would be the case if drivers entered into even the mildest form of competition for the new cabs. From the point of view of comfort and appearance in the streets, he (the speaker) did not think that the general public would look with favour upon these electric cabs, and if the cabdrivers desired to retain an efficient cab service which had secured the approval of the public, notwithstanding the greatly increased competition of 'buses, trams, trains, and steamboats, the present hansom should not be discarded for an ungainly looking, clumsy, and stuffy four-wheeled electric cab. The following resolution was carried: "That this council meeting views with disapproval the introduction of electric cabs on the streets of London, and urges all cabdrivers, in the interest of the cab industry, to discourage any further development of public vehicles driven by motive power." Mr. W. C. Bersey, of the London Electrical Cab Company, has written as follows on this subject to the general secretary of the London Cab Trade Council: "I fail to see how it can be contended that the introduction of electrical cabs can be against the interests of the cabdrivers. We have spoken to hundreds of cabmen on the subject, and have always understood they were most anxious for the change, as it would shorten their hours (by saving the time wasted in changing horses), and also save them the unpleasantness of frequently having to drive tired and undesirable horses. I may add that we have no intention of charging the drivers more than the prices they now have to pay. However, if our electrical cabs possess the objections you mention, the question will solve itself; but so far our experience is that the public are extremely pleased with them."

Charge of Fraud.—Louis Hendlé, described as an electrician, was brought up at the Guildhall on 31st ult., before Mr. Alderman Alliston, charged with having obtained £20 and £340 from Mr. Braham Julian Friend by means of false pretences. Prisoner represented that he was an electrical engineer carrying on business at Paris, that he had works at Silvertown, that he required the money for various purposes in connection with the business, and to enable him to secure certain orders. These statements were personally investigated by Mr. Friend when his suspicions were aroused in August, and he stated before the Court that the works and business were a myth, and that the whole of the representations were false. Prisoner, who admitted he had deceived Friend, was remanded in custody.

The Blackpool Tramways.—We understand that the General Purposes Committee of the Blackpool Corporation on Wednesday adopted a scheme, submitted by Mr. R. C. Quin, the borough electrical engineer, recommending the substitution of the overhead trolley system for the conduit system of tramways now in use. The members of the committee were unanimous in the opinion that a change was necessary as the conduit system was unreliable and costly.

The Cost of Steam Power.—The cost of steam power is now more than ever the subject of anxious study among power users, and electric station operators are eager for any light that can be shed on the matter. But it seems, says the New York *Electrical Engineer*, that it will take some time to reconcile the varying figures presented. One of the most remarkable statements which our contemporary has recently seen is that of Mr. Frank P. Sheldon, mill engineer, of Providence, R.I., who has been investigating the question of cheap fuels in New England, and who communicates some interesting figures to the *Engineering Record* regarding the cost of power in New England textile mills; the figures, it is stated, being obtained from the actual accounts for a year's time, kept by the mill owners. The engines used were compound condensing with steam pressures from 125 to 130 lbs. The engines were of from 1,000 to 1,200 H.P., working against a steady load 10 hours a day for 307 days per year. Mr. Sheldon gives in the following table the highest and the lowest cost per H.P. per year, among several plants examined :—

	Lowest.	Highest.
Fuel	$4.76	$6.60
Labour	2.34	2.71
Supplies	.31	.51
Repairs	.19	.31
Total running expenses... ...	$7.60	$10.13
Fixed charge	4.04	4.72
Total cost per H.P. per year ...	$11.64	$14.85

The fixed charges include taxes, interest at 5 per cent., insurance and depreciation at 5 per cent. The large difference, according to Mr. Sheldon, is chiefly due to the cost of fuel, which in the first or lowest plant cost $1.76 per ton of 2,240 lbs., and in the second, or highest, $3 per ton. These are most astounding figures when compared with others which have gone on record from accepted authorities. Even Dr. C. E. Emery, who will certainly not be accused of having ulterior designs against the perpetuation of steam as a motive power, never approached the rosy figures of Mr. Sheldon. As it happens, Dr. Emery, in a paper read before the American Institute of Electrical Engineers in 1893, gives the result of a very comprehensive study of this question of costs, involving conditions almost identical with those encountered by Mr. Sheldon. Thus, Dr. Emery's figure for a 500 H.P. plant running 308 days of 10 hours each per year, with coal at $2 per ton of 2,240 lbs., with compound condensing engines, is $21.97, or nearly $22 per H.P. per annum; while with coal at $3 per ton the cost was $25.53 per H.P. per annum. Making due allowances for the difference in the size of plant in the two cases, the difference is still far beyond what could be explained in this way. To go more in detail, our contemporary finds that where Mr. Sheldon gives as the cost of coal for the $3 per ton plant as $6.60 per annum, Mr. Emery cites $10.69. Dr. Emery allows 5 per cent. more for interest, depreciation, &c., than does Mr. Sheldon, but even this increased figure fails to account for the great gap yawning between them. The statement that steam power can be produced in New England for $11.64 per annum must sound queer to those who have established themselves at Niagara Falls. However, our exchange editor does not think they need have any regrets; but for the interest and benefit of the entire industry of the country, Mr. Sheldon ought to give a further detailed statement, showing how he arrived at his extraordinary results.

The Morality of the Newspaper Press.—Mr. Maclean, M.P., in his Presidential Address to the members of the Institute of Journalists at Cardiff, said independence was the life-blood of journalism, and that a newspaper, however wealthy and apparently influential, which had lost this saving grace, was really worthless. It would have been more interesting if Mr. Maclean had told us how many, or rather how few, newspapers, come up to this standard!

Mason's College, Birmingham.—It is stated that, in re-arranging the sections of faculties for the next term, the board of this college has converted the lectureship in metallurgy into a professorship. The present lecturer is Mr. W. G. Macmillan, who, it will be remembered, has been appointed to the secretaryship of the Institution of Electrical Engineers.

Lightning Fatality.—The details respecting the death of Major T. C. Jameson, who was killed by lightning near Guildford, on Wednesday evening last week while gathering mushrooms are unusually strange. At the inquest the father of the deceased gentleman said that he was found face downwards quite dead. There had only been a single clap of thunder and flash of lightning. Around him, in a radius of several yards, were his clothes and boots, which had been torn and scattered about in an extraordinary manner. The lightning appears to have struck him on the right side of the head, tearing his cap to pieces, and burning his hair off. It then passed inside his collar, down the front of his body and both legs, into his boots, which were torn to pieces, and then passed into the ground, tearing a hole about 13 inches in circumference and 3 inches deep. His collar was torn to pieces; the front of his shirt was rent into ribbons; the jacket and undervest literally torn to shreds, and the knickerbockers he was wearing were stripped off him and scattered on the ground. His stockings and gaiters were similarly torn in pieces, and on the boots the lightning had a remarkable effect. They were burst open, some of the brass eyelet-holes were torn out, nails were forced out, and the soles torn off. The deceased was wearing his sister's gold watch, and this had stopped at ten minutes past five. The glass had been reduced to powder, the works were blackened, and the small screws twisted out. The skin had been torn off his chest, and his right leg was torn and blackened. When found, blood was issuing from deceased's mouth and right ear. The Coroner said it was a remarkable case, because people generally thought there was less danger from lightning in the open than under trees. There appeared, he stated, to be no doubt that at that moment the lightning must have been going to earth in the exact spot where the deceased was standing. Looking at the remains of his clothes, he (the Coroner) could not realise or imagine what the force of the electric current was. It must have been fearfully powerful. He knew something about electricity, but he could not gauge the force of such a current.

Where the Electrical Engineer Should Not Go.—When the Englishman cannot get a position to satisfy himself in the mother country, he seeks a field abroad in the hope of making a fortune. It often happens that he is no more fitted for service abroad than at home, and he finds this out to his cost after roughing it a bit, and wishes he had stayed at home. This applies to the man who has no particular knowledge on any subject, but fancies that in the rising colony he will find "something" to do which will please him better. In many such cases we may safely say that the man who cannot succeed at home, can hardly expect to do brilliantly abroad. To compare the qualified electrical engineer with this class of men would be inconsistent, for he is a member of a profession which is bound to extend in all parts, and can also get a very fair notion of what country is or is not likely to afford scope for his pent-up energies. Yet the electrical engineer so minded needs an occasional warning. It might happen that the exercise of a little patience would find him a post at home later on which, all things considered, would be better for him in the long run. Our thoughts have been turned to this subject by a communication we have received from a gentleman who is at present at Johannesburg. Though situated there where some Englishmen have an idea there is plenty of room for electrical engineers, he wrote for some reason or other—doubtless because electrical engineers are *not* needed in the Transvaal—to the British Consulate at Yokohama, Japan, saying that reports were current there that a demand existed in Japan for European skilled labour which was well paid, and asked whether that was so. The reply received from the Consul was to the effect that there is *no* demand as suggested, the supply of skilled labour among the Japanese themselves being sufficient for all requirements, at wages quite inadequate for the maintenance of a European. He adds: "There is no opening for an electrical engineer; such works are all managed by Japanese." From this correspondence we gather that neither the Transvaal nor Japan are desirable fields for the English electrical engineer at the present moment.

Appointment Vacant.—A Telegraph Inspector is wanted for the Straits Settlements, on the Perak Government Railways. For particulars see our "Official Notices."

Electric Fittings for 200 Volts.—A correspondent sends us the annexed design for a movable table lamp, fitted with a switch suited for use on a 200-volt circuit. It has been specially made for him by Messrs. Powell & Sons, of Whitefriars. The engineers of electric supply companies and others do not recommend the ordinary combined socket and switch arrangements which are supplied to the market, when required for use on high pressure circuits, the restricted space between the wires and parts being the objection. Up to the present a satisfactory electric fitting of this description for use on high pressure circuits, which latter are becoming

more popular every day, does not appear to have been brought out. In the design here shown, an ordinary 200-volt wall switch is neatly attached to the lower part of the standard, and a flexible cord connects it with the socket. To prevent chafing of the cord where it enters the switch, it may be conveniently wound round one of the limbs of the stand. The arrangement seems to overcome all objections, to be shapely in appearance, and to be well suited for practical use. We understand that Messrs. Powell & Sons, Tudor Street, Whitefriars, E.C., are prepared to supply these lamps to their *clientèle*.

The Postal Telegraphists.—With reference to the further letter from "Telegraph" on page 307 of this issue, our correspondent has certainly not yet made clear the most important points at issue. He has, however, brought this fact to light, that a telegraphist could *not* rise under the Fawcett scheme by regular progression up to a maximum of £190; he could only rise to £100; but he had a *prospect* of rising to £190 *when a vacancy occurred, and provided he was efficient;* the technical examination recommended by the Tweedmouth Commission was, we take it, only a means of determining this efficiency. At the present time, apparently, he can rise to £160, with a prospect of rising to £190 when a vacancy occurs; in other words, whereas he originally could rise from £45 to £100, and then from £100 to £190; he now rises from £45 to £160, and then from £160 to £190. The real barrier, viz., the possible non-existence of a vacancy, existed under the old arrangement just as it does at present; it has always been made to appear, however, as if the rise to £190 under the Fawcett scheme was quite independent of vacancies, and certainly the public and the daily press have been led to believe this. The point about the technical examination proving an insuperable barrier is not a point of consequence, as the examinations have been abolished; our correspondent's statement, however, that there have been very few promotions to the next class since the bar was introduced must, we imagine, be quite incorrect, as we understand that vacancies in the Government service are never left unfilled, and, therefore, if there were any grievance it must have been that of junior men who could pass the examination being promoted over the heads of senior men who could not.

A Puzzle in Motor Winding.—Our trans-Atlantic contemporary, the *Street Railway Review*, is puzzled over a very simple effect due to rewinding the field magnets of a series motor on a tramcar. To the surprise of the electricians the motor runs faster when wound with heavier wire on the field magnets, the number of turns being the same as with the finer wire. The field magnets are no doubt saturated at full load with either winding; but the decrease of resistance in the field allows more current to flow, increasing the torque without increasing the total magnetic flux, thus the thicker wire winding gives greater speed. If the field magnets were below saturation, the speed would not appreciably increase on winding with the thicker wire, for then the field flux would increase and by counter electromotive force check any tendency to increased speed, bnt the field flux being fixed in value any decrease in resistance must result in increased speed.

Award.—At the Electrical and Engineering Exhibition recently held at Newcastle, Messrs. Crompton & Co. were awarded a diploma for excellence of exhibit for electric cooking and heating apparatus.

Correction.—As our readers will have observed, the heading of Mr. Spagnoletti's letter in our last issue should be "Electric Cabs" not "Electric Cables."

Electrical Trades Union.—This Union has recently opened branches at Belfast and Blackburn. Efforts are being made to form a branch at Newcastle also.

Marriage.—Mr. H. W. Appleby (Rosling & Appleby, of Bradford) was married on August 31st to Miss Hilda M. Steavenson, daughter of Mr. A. L. Steavenson, of Holywell Hall, Durham. The employés commemorated the event by presenting Mr. Appleby with a spirit case and by having an excursion to Blackpool.

NEW COMPANIES REGISTERED.

Westralian Electric Lighting and Supply Company, Limited (53,720).—Registered August 12th with capital £100,000 in £1 shares to adopt an agreement with a company of the same name and liquidator, and to carry on the business of electricians, engineers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers are:—B. Fitch, Lauriston House, Grange Road, Ealing, W., gentleman, one share; S. C. Hunt, Hillsiden, Gubyon Avenue, Herne Hill, gentleman, 200 shares; E. Harris, Godalming, gentleman, 200 shares; A. Bull, Finsbury House, E.C., gentleman, 200 shares; G. C. Howard, 16, Tokenhouse Yard, E.C., stockbroker, 200 shares; G. P. Ernest, 57, Moorgate Street, E.C., merchant, one share; B. Nicholson, 39, Queen Victoria Street, E.C., gentleman, one share. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first. Qualification £200; remuneration £800 per annum divisible. Registered by Sutton and Co., 3 and 4, Great Winchester Street, E.C.

Elieson Lamina Accumulator Company, Limited.—(53,748).—Registered August 14th, with capital £65,000, in £1 shares, to adopt undescribed agreement and to acquire, work, turn to account, and deal with the patents and inventions of C. P. Elieson, relating to electric accumulators or storage batteries, to motor cars or vehicles, and to the driving gear thereof. The subscribers (with one share each) are: Earl of Galloway, K.T., 17, Upper Grosvenor Street, W., peer; M. Fradd, 13, Sherborne Lane, E.C., gentleman; E. Smith, 28, Basinghall Street, E.C., accountant; C. P. Elieson, 75, Edith Road, West Kensington, electrical engineer; H. Mackenzie, 57, Upper Clapton Common, N.E., gentleman; J. Cock, 20, Chepstow Place, W.; A. Puleston, 13, Sherborne Lane, E.C., solicitor. The number of directors is not to be less than three, nor more than seven. The subscribers are to appoint the first; qualification, £500; remuneration, £100 each per annum, and £200 for the chairman. Registered by A. Puleston, 13, Sherborne Lane, E.C.

Ventnor Electric Light and Power Company, Limited (53,823).—Registered August 21st with capital £15,000 in £5 shares, to carry on the business of electricians, electrical engineers, practical engineers and contractors, electrical apparatus manufacturers, &c. The subscribers (with one share each) are:—F. E. Gripper, 19, Gt. George Street, S.W., electrical engineer; J. C. Wigham, Albany House, Monkstown, Co. Dublin, electrician; C. H. Jones, 41, Burleigh Mansions, W.C., accountant; F. Trueman, Church Street, Ventnor, outfitter; F. Sims, High Street, Ventnor, hotel proprietor; W. H. Bull, 28, Pin Street, Ventnor, confectioner; W. T. Pressland, Westcott, Dorking, engineer. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification one share; remuneration as fixed by the company. Registered office, 19, Gt. George Street, Westminster.

Electro-Neurotone Company, Limited (53,849).—Registered August 25th with capital £5,000, in £1 shares, to acquire any invention relating to the production, treatment, storage, application, distribution, or use of electricity, and to carry on the business of electricians, engineers, machinists, fitters, founders, &c. The subscribers (with one share each) are:—T. G. Lloyd, 78, Queen Victoria Street, E.C., merchant; H. D. Sinclair, 19, Silver Street, E.C., manufacturer; T. C. Hodgkinson, 35, Westcroft Square, W., electrician; E. R. Baines, 47, Boswell Road, Thornton Heath, clerk; T. Salmon, 9, De Laune Street, Kennington, S.E., clerk; H. G. Campion, 90-91, Queen Street, E.C., gentleman; C. Griffith, 78, Queen Victoria Street, E.C., gentleman. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first. Remuneration 6 per cent. of the net profits divisible. Registered by Campion & Simmons, 90 91, Queen Street, E.C.

Townsend, Tamplin & Makovski, Limited (53,914).—Registered August 30th with capital £20,000 in £10 shares (1,000 "A" and 1,000 "B"), to acquire the business carried on by W. E. Townsend, at 68, Victoria Street, S.W., and the business of S. W. G. Tamplin and A. W. Makovski, of 11, Victoria Street, S.W., to adopt certain agreements, and to carry on the business of consulting electrical, mechanical, and general engineers. The subscribers (with one share each) are:—S. W. G. Tamplin, 8, St. James's Square, S.W., electrical engineer; W. E. Townsend, Lyndale, Mt. Park Road, Ealing, civil engineer; S. Makovski, Fairlawn, Redhill, flour merchant; Mrs. S. Makovski, Fairlawn, Redhill; Miss M. B. W. Makovski, Fairlawn, Redhill; A. W. Makovski, Fairlawn, Redhill, electrical engineer; A. M. Shepherd, 32, Albany Road, Ealing, W., accountant. The number of directors is not to be less than three nor more than seven; the first are S. Makovski (chairman), W. E. Townsend (managing director), S. W. G. Tamplin, and A. W. Makovski; qualification £100; remuneration as fixed by the company. Registered by Mauders & Tunnicliffe, Arundel House, Arundel Street, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Power Storage Company, Limited (30,313). This company's annual return was filed on July 29th. The capital is £100,500, in £5 shares (100 founders'); 66 founders' and 18,357 ordinary have been taken up, and 15,220 ordinary are considered as paid; £3 per share has been called on 3,137 ordinary, and £5 per share on 66 founders', and £9,618 7s. 4d. has been paid, while £121 15s. 6d is in arrears; £400 has been paid on four founders', and 400 ordinary shares forfeited.

United River Plate Telephone Company, Limited (23,654).—This company's annual return was filed on July 28th, when 58,000 shares were taken up out of a capital of £500,000 in £5 shares. 16,000 are issued as fully paid, and £210,000 has been called and paid on the rest.

Midland Electric Light and Power Company, Limited (16,166).—This company's annual return was filed on July 13th, when 3,139 shares were taken up out of a capital of £50,000 in £10 shares. 3,132 of these are considered as paid, and £70 has been paid on the others.

Llandudno Electric Supply Company, Limited (41,382).—This company's 1896 return was filed on June 17th last, when 18 shares were taken up and paid for in full out of a capital of £15,000 in £10 shares.

Exchange Telegraph Company, Limited (6,152 C).—This company's annual return was filed on August 13th. The capital is £246,250 in £10 shares (8,125 "A" and 16,500 "B"). All the "A" and 16,200 "B" shares have been taken up, and the latter are considered as paid, while 2,125 "A" shares have been issued with £8 per share considered as paid. £9 per share has been called on 6,000 "A" and £1 per share on 2,125 "A," and £56,023 has been paid. £816 has been paid on 102 forfeited shares.

Coventry Gas Fittings, Electrical and Engineering Company, Limited (22,431).—This company's annual return was filed on July 31st. The capital is £15,000, in £1 shares; 14,418 shares have been taken up, and 500 are considered as paid; £1 per share has been called on the others, and £13,794 has been paid, leaving £124 in arrears.

CITY NOTES.

Brighton and Rottingdean Seashore Electric Tramroad Company, Limited.

The fourth ordinary general meeting of the shareholders of this company was held at the offices, Madeira Road, Brighton, on Saturday afternoon, Mr. E. O. Bleackley (chairman of the directors), presiding.

The directors, in their annual report, stated that they were pleased to announce that the repairs necessitated by the disastrous gale of December last had been completed. The car had been reconstructed in an improved manner, and equipped in a most sumptuous way. The line was re-opened on Tuesday, July 20th, and was being well patronised by the public, and the passengers were so satisfied with the excursion, that many went day after day. After a long and trying period, the directors trusted that the shareholders were within measurable distance of a substantial return for their investments. The debenture interest for the year 1896 had been paid. Mr. Volk had foregone his claim to £149 9s. 11d., due up to June 30th, 1896, and had also given his services and foregone all commission from that date up to the date of re-opening the line, a period of over 12 months, representing a saving to the company, in all, of about £629. The directors regretted to announce that the company's secretary, Mr. F. J. Cully, died in May last. Mr. Magnus Volk had agreed to act as secretary *pro tem.*

The Chairman, in moving the adoption of the report and balance-sheet, said they would understand something of the worries and anxieties of the past nine months when within a week after such a successful opening a great part of the undertaking was destroyed. In reconstructing the car many improvements had been introduced, from which they hoped to derive considerable benefit. The protective works at Greenways were well in hand, and would be available during the forthcoming autumn and winter. Although they did not anticipate a repetition of last winter's disaster, the car and the jetties had been insured, so that any future loss would not fall upon the company. Since the re-opening scarcely a day had passed (save two or three boisterous days) without the booking having to be suspended, the full complement of tickets having been sold. Owing to a miscalculation of the contractors for the engines, they had not been able to run the car so fast as they expected, but still at a very satisfactory speed, and the makers of the engine had promised to make them give more power, but during the present busy season, as no alterations could be carried out without suspending the traffic, little could be done in that direction. One thing was fairly certain—that the public appreciated the novelty of "a sea voyage on wheels," and were quite ready to avail themselves of all the reasonable accommodation they could offer them. There was no doubt if they built another car their traffic would at once double itself.

Mr. C. H. Nye: There will be another?

The Chairman: Well, we hope so. It is simply a matter of funds. We have learned how to build one cheaper.

Mr. J. J. Clark, J.P. (director) in seconding the proposition said it was a very common thing to see large numbers who were anxious to make a trip left behind. This was very satisfactory to the directors in this sense—it showed that they were not such fools as people took them to be when they projected this great novelty. They were aiming at greater regularity of traffic, and when the intended alterations to the engine were carried out they would be able to run to Rottingdean and back every hour. He was quite sure that then they could do that their receipts would be increased enormously. Handicapped as they were, the traffic for the last five weeks had been very satisfactory, for it had been something like £125 per week, and he had no doubt that during the summer months their traffic, with a powerful engine, would come up to £200 a week. If it did, large as their capital now was, the shareholders would get a very fair return for their money. As was not unusually the case with railways, the laying of the line had cost a great deal more than was anticipated, and they would shortly be issuing, in order to raise sufficient capital, 8,000 preference shares, which would constitute a first charge on the revenue of the company after debentures. The interest on debentures was only £300 last year, and therefore he thought they would agree with him that 6 per cent. preference shares would be a really first class investment. Their expenses were only about £1,200 or £1,300 a year, and no doubt their revenue would be at least £3,000 a year, so that there would be a very large margin to pay the interest on preference shares. He hoped, therefore, that these preference shares, which would be issued in the course of a week or two, would be readily taken up by the public, and that some of them would be taken up by ordinary shareholders.

The resolution was carried, and Mr. E. O. Bleackley, the retiring director, and Mr. J. T. Haslam, the retiring auditor, were re-elected.

The proceedings closed with a vote of thanks to the chairman.

The Brush Electrical Engineering Company, Limited.

—The directors have decided, after placing £5,000 to reserve fund, to recommend payment of the arrears of dividend to the preference shareholders for the year 1895, and a dividend at the rate of 4 per cent. per annum on the preference shares for the year ended June 30th, 1897, leaving a sum of about £3,000 to be carried forward to next account. The transfer books will be closed from September 1st to 18th, 1897, inclusive.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending August 29th, 1897, were £838; week ending August 30th, 1896, £835; increase, £3; total receipts for half-year, 1897, £8,152; corresponding period, 1896, £8,233; decrease, £181.

The Liverpool Overhead Railway Company. The receipts for the week ending August 29th, 1897, amounted to £1,535; corresponding week last year £1,300; increase, £235.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending August 27th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,934

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Aug. 25th.	Closing Quotation, Sept. 1st.	Business done during week ended Sept. 1st, 1897. Highest.	Lowest.
149,900£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph, Limited, shares	10	...	...	...	5 — 6	5 — 6	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	£2 13s.	54 — 57	56 — 59	57	56½
3,038,020£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	£5 6s.	101 — 102	103 —104	104	101½
3,038,920£	Do. do. Defd.	Stock	...	...	...	10½— 11	11½— 12	12	10¾
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	15 — 15½	15 — 15½	15⅝	15½
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	4 %	3½— 3⅝	3½— 3⅝xd	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	180 —185	180 —185	...	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	106 —107	106½—107½	107½	106⅝
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	2 %	⅞— 1	⅞— 1	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	9 — 10	8½— 9½xd	8⅞	8½
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	18½— 19½xd	19½	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9½— 10½	9½— 10⅝	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000	50	4½%	4½%	4½%	103 —106%	103 —106 %	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	2½%	9½— 10	9⅝— 10⅛	10 3/16	9 15/16
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	6½%	16⅝— 17½	16⅝— 17½	17⅛	16⅝
70,000	Do. 6 % Cum. Pref.	10	6 %	6	6%	17½ — 18½	17½ — 18½	18½	...
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5%	101 —104	101 —104	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4%	129 —132	129 —132	131½	130½
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	10	7 %	7 %	7⅛	17½ — 18	17½ — 18	18	17⅝
35,500£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5%	99 —103	99 —103	...	...
133,100£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5%	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4%	128 —131	128 —131	...	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5%	99 — 103	99 — 103	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5%	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4%	103 —106	103 —106	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4%	107 —110%	107 —110 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11½— 12	11½— 12	11⅞	11⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6%	16⅝— 17½	16⅝— 17½	17	16⅝
150,000	Great Northern Teleg. Company of Copenhagen	100	8⅝%	10 %	10%	26½ — 27½	26½ — 27½	26⅝	...
160,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5%	104 —107	102 —105 xd	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10%	54 — 57	54 — 57	...	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6%	107 —110	104 —107 xd	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000	5	4 %	4 %	...	2 — 2¼	2 — 2¼	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	5½%	6⅜— 6⅝	6⅜— 6⅝	6⅝	6⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	15½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6½	6 — 6½	6¼	6 3/16
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —110	105 —110	109	108
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4½%	5 %	5 %	⅝— ¾	9/16 - 11/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 —110	107 —110	...	...
11,839	Reuter's Ltd.	8	*nil*	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	135 —140	135 —140	...	...
58,000	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3½— 4	3½ - 4	3¾	3 13/16
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	100 —105	100 105	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	4 %	nil	5 — 6	5 — 6	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	102 —105 xd	...	...
64,256	Western and Brazilian Teleg., Ltd.	15	3 %	3 %	2 %	9 — 9½	9 — 9½	9 3/16	9
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	6⅞— 7¼	7 — 7⅛	7¼	7
33,129	Do. do. do. Def. Ord.	7½	1 %	1 %	...	2¼— 2⅜	2¼— 2⅜	2⅜	...
382,230	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	101 —104	101 —104	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	⅞%	1 %	⅞— 1⅛	⅞— 1⅛	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 10½	10 — 10½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	8 — 9	8 — 9	10½	10
80,000£	Do. do. 5 % Debs. No. 1 to 1,600	100	5 %	5 %	5 %	105 —108	105 —108	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7 %	7%	106 —110	106 —110	...	...
160,100£	Do. do. 5 % Ster. Bonds.	100	5 %	5 %	5%	103 —106	100 —105 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	6 %	12½— 13½	12½— 13½	13 3/16	12⅝
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6¼	6⅛
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	5 %	9⅝— 10½	9⅝— 10½	10 1/16	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	...	4½%	4½%	110 —113	110—113	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	7 %	23½— 24½	23½— 24½	24½	24½
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17½	17 — 18	17⅝	17½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	130 —135	130 —135	...	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	*nil*	*nil*	12⅜— 13½	12⅜— 13½	...	...
20,000	Do. do. 6% Pref., 40,001—60,000	10	...	6 %	6 %	15 — 15½	15½— 15⅝	15½	15
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...		9 — 9½	9 — 9½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	3 %	4 %	5 %	16½— 17½	17 — 18	17	...
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem.	10	...	...	...	16 — 17	16 — 17	...	...
220,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	118 —122	118 —122	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	4 %	15 — 16	15 — 16	15½	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	10½%	17 — 18	17 — 18	17⅝	17½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	...	102 —105	102 —105	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 68,000	5	5 %	7 %	9 %	14½— 15½	14½— 15½	15 5/16	15 1/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, August 25th.	Closing Quotation Sept. 1st.	Business done during week ended Sept. 1st, 1897. Highest.	Lowest.
20,000	British Electric Traction	10	...	...	...	13¼ — 13⅜	13¼ — 13⅜	13⅜	...
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	5	2½%	...	...	1 — ¼	1 — 1¼	1 1/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	1¼ — 1⅜	1⅛ — 1⅜	1 11/16	1 5/16
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	...	...	105 —109	103 —107 xd	103½	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	93 — 97	94 — 98	97	...
19,126	Central London Railway, Ord. Shares	10	...	...	...	9⅜ — 10¼	9⅜ — 10¼	9 15/16	...
143,106	Do. do. do. £6 paid	10	...	...	...	5⅜ — 6¼	5⅜ — 6¼	...	...
58,830	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1½ — 1⅝	1½ — 1⅝	...	...
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼ — 4⅜	4¼ — 4⅜	...	...
630,000£	City and South London Railway	Stock	1½%	1 11/16%	1 9/16%	65 — 67	66 — 68	67½	66
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1½ — 2	1½ — 2	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	...	2¼ — 2⅜	2¼ — 2⅜xd	2 7/16	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	...	4 — 4½	4 — 4½	4 5/8	..
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	6 %	1⅝ — 2	1⅝ — 2	1⅝	1 13/16
16,343	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2⅞ — 3⅛	2⅞ — 3⅛	3	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	⅝ — ¾	⅝ — ¾	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ..	2	*nil*	...	...	½ — ⅝	½ — ⅝	...	..
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ..	10	*nil*	10½%	..	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	18½ — 19½	18½ — 19½xd	18⅝	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18 — 19 xd	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	109 —114	109 —114 xd	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	20½ — 21½	20½ — 21½	21½	21 3/16
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	105 —108	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	2⅝%	2⅝%	11⅞ — 12 xd	10⅞ — 11½	...	.
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16½ — 16¾xd	16½ — 16⅞	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	37 — 40	37 — 40	38½	38¼
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	103	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £8 paid ...	10	...	...	...	10⅞ — 11¼	10⅞ — 11¼	10 13/16	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 60% for 1890.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* **Birmingham Electric Supply Company**, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9½.

Electric Construction Corporation, 6 % Debentures, 104 – 107.

House-to-House Company, 7 % Preference, of £5, 10½—11.

Do. do. 4½% Debentures of £100, 107 –111.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 13 —13½; 1st Preference Cumulative 6 %, £5 (fully paid), 8 —8½. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 1⅝ –1⅞.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

Bank rate of discount 2 per cent. (May 13th, 1897).

ELECTRIC PLANT RUN BY WIND.*

THE first successful attempt to put to practical use an electric plant, run by a windmill, has just been accomplished by J. J. Feely, a well-known lawyer of Walpole, Mass., with a penchant for mechanics.

With wind as the fundamental factor he operates a private light plant, forces water all over his estate, operates farm machinery and cuts wood. From an electrician's point of view the greatest obstacle, and one which it was claimed could not be overcome, was the variability of the wind and the consequent erratic fluctuations of the electric pressures, which rendered their utilisation impossible by subjecting the ordinary mechanical connections to excessive and fatal strains.

Early in his experiments Mr. Feely found that one of the first problems to be solved was to determine accurately the wind velocities and efficiencies during the various months of the year. This was determined by the use of an anemometer, made especially for that particular purpose and very similar to those in use by the United States Weather Bureau, with the exception that while the government instruments record the mile rate of the wind, the one made for Mr. Feely recorded the wind at each fiftieth of a mile. The windmill proper is the ordinary kind common in all out-of-town and country places where there is no public water supply. The steel frame or supports extend 50 feet above the second story of the stables.

At the top of this frame are the wheel and fan which are operated by the wind. As the wheel revolves under the influence of the slightest breeze it operates a series of cog wheels which work upon a long vertical shaft running from the head of the machine to the basement or cellar of the stables, where it communicates with a second shaft leading directly to the dynamo of the plant.

From this dynamo lead two sets of wires. One set carry the current to the various parts of the estate, where it is utilised for power purposes and for lighting, while the other set of wires receive the surplus current and store it in storage batteries for use when the wind is not sufficiently strong to give power enough to supply the necessary voltage. When there is a high wind there is naturally a much stronger current than is necessary and in order that it may not be wasted or play havoc with the lights the surplus energy is led into these storage batteries and there kept until needed. A feature of this dynamo is that the same one which generates the current when there is a breeze also acts as a motor during a calm and can be used with the energy always on hand in the storage batteries. This double service by a dynamo has never before been accomplished.

Once the practicability of the machinery was assured Mr. Feely lost no time in putting electric lights throughout his house and stables and about his private grounds and utilising the new agency for various household and farm purposes. The whole secret of the success of his work is in the dynamo, which, in a number of ways, is different from the usual electric dynamo. In an ordinary dynamo the voltage depends upon the speed with which its armature is driven, and it was found that owing to the various speeds at which the windmill was driven an ordinary dynamo would be entirely useless for such purposes as Mr. Feely intended, hence it was necessary to construct the special one. In devising such a dynamo it was essential that it should be self-regulating.

When the dynamo was tried it was found to work perfectly. By keeping the voltage perfect it was found that substantially all the power of the windmill, however erratic, could be utilised by simply increasing the current in proportion to the increase of the speed of the windmill. During his experiments in ascertaining the varying changes in the velocity of the wind, Mr. Feely found that there is not as great a difference as is generally supposed between winter and summer winds. During the mid-summer months he found that the wind averaged eight miles an hour, while during the winter months the average was about nine miles an hour. One of the most important features of this new contrivance is what is called a speed equaliser of special construction, by which the surplus energy generated by high winds is mechanically stored and delivered to the batteries in a comparatively uniform manner.

As it is necessary that a dynamo must attain a sufficient velocity to give an electromotive force sufficient to overcome the back electromotive force of the battery it was therefore necessary to devise some means of preventing the current from the storage battery passing back to the dynamo when not needed. This was accomplished by a device, which, when the electromotive force of the dynamo rose to a given point, would connect with the circuit, thereby sending it into the storage battery, and again opening the circuit, when, owing to decreasing speed of the dynamo, the electromotive force falls below that of the storage battery.

* *Philadelphia Times.*

THE ELECTRIC PLANT OF MODERN TALL BUILDINGS.

If we are to judge by the illustrations of the newer tall buildings of America, there is a tendency to make of these simply towers. Earlier tall buildings like the Mill's Buildings were of considerable area, but the craze has spread to small owners—*i.e.*, owners of small plots—and buildings have been run up as high as a factory chimney on any little ground space. It follows, therefore, that the question of providing isolated power plants for such buildings becomes a degree more debateable than if such buildings were of larger cubic capacity. Excepting in the question of elevators, which have made these hideous structures possible, or rather practicable, there is no special difference in the plant required from what would be necessary in any ordinary building of equal bulk. While it is to be devoutly hoped that the tall building will never find a home in England, yet much of its economy might well be adopted here in buildings of moderate height. In a New York office building of 300 rooms, there will be four elevators, and only one staircase. Compare this with that range of buildings in Victoria Street, S.W., occupied by the Colonial headquarters in London, where we find, in a comparatively small block of buildings, a large number of separate and independent entrance doors, and for each entrance an enormous amount of waste space in the matter of hallways, and, we think it is, two staircases to each entrance, and capacious landings on each floor.

Now if these buildings were pulled down from end to end, and rebuilt as a single one-entrance building, there would be saved many doors, and much hall space, while landing space would be reduced to a minimum, and these toilsome buildings could be served well by a couple of elevators. There would be no need to reproduce the hideousness of the American building. Indeed, with moderate height, no tendency need be felt to do so. The trouble with London offices which have elevators is that in a small building one elevator is too much. There is not anything like constant employment for the attendant, and he looks on it as a grievance to be asked to attend to even such little business as he has to do. In a building of 300 rooms three or four elevators can be kept constantly employed, and the men are always at their posts, and one is not kept waiting, as at Leadenhall House, nor could the maddening slow coal conveyors which do duty for elevators at the Rabbit Warren or 11, Queen Victoria Street, be held justified. The question of the machinery in the tall buildings is discussed by Mr. F. A. Pattison in the *Engineering Magazine*, and with the one exception of the elevators, may be taken as useful for any large building. One thing is imperative; there must be no vibration from the machinery communicated to the building.

It is, therefore, necessary to insulate machinery foundations from building foundations. Where foundations are floated on a grillage, insulation may be effected with sand held by brick walls. Heavy felt is sometimes used, but the most satisfactory foundation is a single large mass of concrete or masonry for all the machinery. For machinery, three, or at most four units, should be employed. The duty should be done by as few cylinders as possible. It is recommended for direct connected plant to eschew any coupling, and use simply an extended shaft for the engine, the extension of the shaft serving for the dynamo. With proper foundation and sub-base, no question of alignment need arise. Engines should be preferably self-oiling throughout; the dynamo must be compound wound with a broad commutator and carbon brushes; 220 volts are now possible with the introduction of the 220-volt lamp. Lights and elevators cannot be run off the same dynamo. Either a storage battery must be employed, or else the elevator generator units must be sub-divided and placed on one shaft run by one engine, so as to allow the different elevators to equalise the load. Every wire from every dynamo must travel *via* the switchboard, which must be properly supplied with instruments, to show the condition of each dynamo. The "board" must be fireproof, away from chance of accident or meddling.

Storage batteries are recommended and of sufficient size, placed by themselves in a well ventilated shut-off room with drained sloping floor.

Finally, all the machinery must be placed in a clean, light, and airy room, and not put away in any ill-ventilated dirty corner, where neither men nor machines could be either efficient or clean. Recent enquiries in London have demonstrated to us that there is already a large field for the use of electricity that is yet untouched, and we believe also much room for isolated plants if only the problem of the mechanical engineering of large buildings could be properly handled.

ACCUMULATORS: THEIR APPLICATION TO CENTRAL STATION LIGHTING AND POWER.*

Considerable misconception seems to exist in reference to the cost of installing a storage battery. Like all good things having value, accumulators are not given away, and the station manager who is waiting for them to get cheaper is letting one-third of the earning power of his station go to waste. Local conditions of course determine the capacity and consequent cost of battery, but in general terms the cost may be stated to be less in most cases than the cost of generating plant.

When it is desirable to increase the capacity of a station, it means besides new dynamos, increase in engines, boilers and all steam appliances, and usually alterations in the building, and while the output of the station is increased, the general efficiency remains about the same, and oftentimes the running expenses of a moderate sized station is greater per H.P. output, owing to the increase in the working staff.

On the contrary, to increase the capacity of a station with accumulators requires as a rule no alteration or increase of existing steam plant, no new dynamos, and usually, owing to the small space required, plenty of room can be found in the station for the storage battery.

When such a change can be made, what are the results? The available output of the plant has been largely increased. No increase in working staff is required. The operating expenses are no higher than before. The all round efficiency of the station is fully 30 per cent. more, and consequently, the profits are enlarged by nearly the same proportion. The plant can thereafter give uninterrupted service, 24 hours per day, every day in the year, as the battery is always available when a temporary shut down of the machinery is necessary. The regulation of the voltage to the lamps is kept constant, more perfect than can be possible when no batteries are used, as the battery is a regulator to the whole system. When motors are operated, this is a big advantage.

No gas company would, for a minute, consider the operation of its plant without a storage tank; just think of the large increase in retorts and men to keep up a constant gas supply, without a storage tank. Most waterworks systems require a reservoir, and yet electrical people, who are supposed to keep abreast with the times, try to get along without a storage tank to fall back upon for hours of maximum, minimum, or average demand.

The central station manager will answer that he does not know the cost of maintenance and is waiting for the other fellow to prove the case. The other fellow has proved it. In Germantown, Pa., there has been a battery having a capacity of 120 H.P. hours, in use for over three years, or long enough to give a fair idea of the cost of renewals. The management of the large stations in Boston, Brooklyn, and New York, however, did not await the results in Germantown, but put in large batteries from one to two years ago, and these have since been doubled, and in one case, enlarged for the fourth time.

* Read before the Canadian Electrical Association, by W. A. Johnson.

But interested parties can go back of the returns from the United States for further evidence of the practicability of accumulators. In Germany, France and England, they have been largely used for years past. Out of a recently published list of 30 cities in Germany, only 10 are without accumulator plants. The population of these cities ranges from 4,000 to 850,000. This shows that there is hardly a town or city electric plant but can use accumulators to advantage.

I mention the following among American companies who have put in large batteries and the capacity installed as rated in H.P. hours:

Company.	H.P. hour capacity.
Hartford Electric Company	3,000
Boston Edison Company, four batteries, a total of ...	7,400
New York Edison Company...	3,200
Brooklyn Edison Company	1,600
Germantown Electric Light Company	300
Electric Railway, Light and Power Co., Anaconda, Mon.	500
Woonsocket Electric Machine and Power Company ...	400
Easton (Pa.) Edison Company	200

These last three plants are used both for railway and lighting work.

As good an illustration as I can give of the application of the storage battery to railroad work is to refer to the equipment of the Union Traction Company of Philadelphia, which uses a battery of 400 H.P. hours for keeping up the pressure at the end of a feeder at a point about 11 miles from the power house, the new extension continuing several miles beyond; in this case the battery took the place of a new power house or what amounted to the same thing, an increase at the old power house with enlarged feed wires. It was found that the cost of copper feed wire to operate from the main power house, alone, would have cost four times the total cost of the battery. Previous to the installation of the battery, the pressure at the end of the feeder formerly in use, frequently varied as much as 50 per cent., the battery however, gave practically a steady pressure at all times. Railway men need not be told how much better for their motors and controllers the maintenance of a standard working pressure is, than one which falls so low as to require an increase in the current passed through the apparatus, of from 50 to 100 per cent. In the above case, the load varied from 100 to 700 amperes, and with the feeder of a capacity at a constant load for 400 amperes, the demand upon the power house was at all times equal and independent of the changeable load on the batteries.

Under such an arrangement, the power house generator always operates at full load and highest efficiency, and the battery acts as a cushion to the engine when the line circuit breaker opens from any cause.

Some of the electric street railways in Canada, serve a district up to 7 miles from the power house, as originally laid out, and in all cases extension will be called for to reach suburban points at a greater distance and to connect through as radial lines to still more distant points. In such work, the accumulator plant at the end of a feeder is destined to be an important factor in the near future, and the little trouble in operating a sub-station for this work is very satisfying to the purchaser, as the battery is automatic in charge and discharge, the only attention required being the usual occasional testing of the E.M.F. of the individual elements and the keeping of the electrolyte to the standard specific gravity (1·200). The sub-station apparatus and connections are very simple, being only the main switch, ammeter, circuit breaker, voltmeter and recording voltmeter. The flow of the current to the line being always proportionate to the demand. One central station can therefore take care of any number of accumulator sub-stations, and the area which can profitably be covered with continuous current either for railroads, lighting or power greatly increased.

The claim has been made, and experience seems to prove it true, that it costs practically nothing for the energy stored in accumulators in the average lighting, power or railroad station, whether operating on a 12 or 24 hour basis, as, if judgment is used in proportioning the size of the battery to the generating plant, the battery is always being charged during light load and discharged during hours of heavy load, and owing to the all round higher efficiency, the amount of coal burned will be about the same and the current given off from the batteries will represent net profit.

While the above is a simple way of putting it, the following gives in figures the actual conditions obtained in a plant now working:—

Total time of operating steam plant, 9 hours.	
Total steam plant required, dynamos working at an efficiency of 90 per cent.	93 H.P.
Total steam plant required if battery is not used	165 H.P.
Saving in steam plant	72 H.P.
Total dynamo capacity required when using battery	62,500 watts.
Total dynamo capacity required without battery	111,250 „
Saving in dynamos	48,750 „

In this case the battery was in service a total of 18¼ hours, and during 15 hours the battery served the entire plant.

In making provision for a storage battery the room provided should, if possible, have a cement or tile floor, and should be well ventilated. Owing to the compact form of the elements, sufficient room can usually be given when arranged in tiers, one above the other. The space required for a battery capable of giving 400 H.P. for one hour, is $14\frac{1}{2} \times 20\frac{1}{2}$ inches per element, and as 248 cells would be used on a 500-volt system only about 630 square feet would be necessary, this being for a battery of fairly large capacity, in fact being equivalent to that installed by the Union Traction Company in the before mentioned instance.

A suitable battery having been purchased, it requires as careful attention as is given to any other class of electrical or steam apparatus, and no more, and yet this attention is very simple, but it must be given as required, otherwise the results would be similar to that caused by neglect of a dynamo or steam boiler. There has been no instance where a properly constructed battery that has received fair treatment has failed to give good results. Attention should be paid to the proper strength and nature of the acid, the specified gravity of the acid being tested at regular periods; the individual testing of each cell by a low reading voltmeter is the keynote to successful battery operation. While in general the reading of the voltmeter connected with all the elements will give sufficient information, yet the occasional individual testing of each element prevents any single cell from being allowed to work at a disadvantage. The chloride type of negative plate has been found to be most satisfactory, and is largely in use for central stations. The positive plates generally used with chloride negatives are of the Tudor type, and are capable of giving a very high discharge, their capacity being at nominal rating from 3 to 5 ampere hours per lb. of element. Such a battery is not liable to buckle or sulphate. There are numerous small water powers that have not been considered as applicable to electric lighting owing to the small power available, but if 20 H.P. can be obtained for 24 hours per day, and if a battery is used in connection therewith, 120 H.P. is available for four hours, or sufficient for the requirements of a fair sized town. I know of one instance, in a town of from 8 to 10,000 inhabitants where a water power of 50 H.P. is available and not used at present. This power if stored in batteries would give 200 H.P. for six hours, or sufficient to supply all the street, commercial and residential lighting which is now operated by steam.

ELECTRICITY IN THE MODERN MACHINE SHOP.

Continuing his articles in the *Engineering Magazine* Dr. Louis Bell refers to many of the smaller yet still very important uses of electricity. Though we do not share his admiration of American plating, which is carried to tawdry lengths, we can fully appreciate the reproductive powers, as seen in electrotypy. In metal reduction as with aluminium it is certain that electricity will be now promptly called in to reduce any metal whose properties seem to make its larger production desirable. The use of the electric arc for welding is alluded to especially for the convenience of our friends the burglars, and might often be usefully employed by honest mechanics to aid them with hard metals. Already the X ray has been used to examine inside cases and show certain slipped wires. The author thinks that by means of an exploring coil sliding along even a huge screw shaft its soundness might be ascertained exactly as may be

already that of a small rod in the laboratory. There are some 50 metallic elements known to chemists. About a dozen of these are used to any extent in the arts. Yet the furnace which has given carborundum and aluminium will help to explore many others, or to making fresh alloys. To us it seems that it will be almost more on physico-chemical lines that electricity will work out its future. Electricity in the workshop may effect three savings, namely, of power, of labour, and the saving by new processes. The first is its more immediately secured economy, the second is secured rather by ingenious applications than on any defined system, and demands special appliances. But it is in new processes that the greatest economy must come. A new process may mean not simply a cheaper process, but the accomplishment of what has hitherto been impossible. The near future is likely to see great strides in this third and greatest of all economies due to electricity, because in this direction we are likely to accomplish what have hitherto been impossibilities, whereas in purely mechanic arts as in short distance power transmission electricity is but replacing a rope, or a belt, a piece of shafting, or a pipe of air, water, or steam. The economy may be questioned; the doing of something new in chemistry cannot be well gainsaid, especially when new compounds like carborundum are produced.

DO WE KNOW HOW TO PACK MACHINERY?

We are giving so much attention nowadays to the extension of our foreign trade that it is just possible we may forget that the custom we have already secured may slip through our fingers unless we let our clients see by the way we execute their orders that we are anxious to retain their business. English manufacturers have long been credited with supplying a first-class machine or tool, but we venture to say that many of the foreign firms who buy from us would rather have a somewhat inferior article if it arrives at its destination in good condition than an excellently made and finished article which is considerably injured in transit through the want of good packing. For instance, when goods are wanted in a great hurry, is it not better to have a machine arrive whole and fit for immediate work even if it may not be quite so good or last so long, than to find that a machine for which a higher price has been paid has arrived with certain parts broken or injured to such an extent that some time has to be wasted on repairs, or a new part, or parts, ordered by cable from home to replace them, before any work can be got out of the machine. Such cases as these, if repeated, may be calculated to overcome all the desire that the foreigner may have to trade with the British, especially when other countries are only too eager to get their business. Columns and columns of useful matter have been published in the home papers pointing out the weak points in our foreign trade methods, and saying that this, that, and the other matter must have greater attention than hitherto if we are to go ahead, or even to retain what we already have.

The consular reports to the Foreign and Colonial Secretaries bristle occasionally with very valuable hints for British exporters, and, we believe, many firms of this class watch with considerable interest for these official publications. Written by men situated on the spot, men who have every opportunity for hearing opinions and of getting information regarding future business, they frequently touch upon weak points, and disclose the strong points of our foreign competitors. Of course, we are aware that the consuls of other countries are advising their exporters in a similar manner, but this fact only makes it the more necessary that the case viewed from the British standpoint, through the eyes and understanding of a Britisher, should receive the greatest possible attention.

Few of the evils brought to light in this way are referred to by foreigners themselves with such unfortunate regularity as is the all-important question of packing. One so often hears of the matter, that we are coming to the conclusion that the British, though a nation of shopkeepers, are very poor packers.

Particularly does this packing question interest electrical firms, as we are frequently hearing of valuable instruments injured in transit through failure in this respect. We cannot do better than conclude our few remarks on this subject by reproducing from the *Review of the River Plate* the following paragraph, which should have considerable weight:—

> Our attention has frequently been drawn to the carelessness displayed by English electric firms in the packing of goods for this market, in which they are doing more than they imagine to forward the interests of Continental and American firms. We have seen whole consignments of Leclanché batteries arrive in a condition only fit for the scrap heap. A firm recently sent out some storage batteries for train lighting *filled with acid*. Others have sent out delicate testing instruments with absolutely no protection for the pivots or suspending silks of the needles, and a couple of days ago we were shown a Röntgen ray set that had been sent out to the British Hospital. The induction coil was smashed, and, to use one of the committee's own words, "It had not been packed with sufficient care even for sending across the street." This, to say the least of it, is scandalous. Quantities of goods are paid for before they leave England, and the purchaser on this side has absolutely no way of recouping himself, or of making the shipper responsible for his culpable negligence. We trust the English technical press will give this question due publicity. The fault is not on this side, as goods are taken out of the vessels by hydraulic cranes, placed in the Custom Houses, and handled with great care. The fault rests solely with the shippers for not knowing how, or not caring, to pack properly. They are never behind hand, however, in charging for cases and packing.

We would advise manufacturers to give greater attention to their packing department, for want of care there may spoil the work of every other department, however excellent it may be. A good reliable packer who thoroughly understands his business and knows how much depends upon the careful execution of his duties, is not to be despised.

THE ECONOMY OF THE MODERN ENGINE ROOM.

In an article on the care of plant, written by Mr. T. Carpenter Smith in the *Engineering Magazine*, we may pass over the first portion which deals with the management of men, a thing not easy anywhere, and perhaps less easy than elsewhere in America, where the tendency of so large a section of the public is to do things in a slovenly manner and assume a certain manner as though to try and say they were really too good for their job, and only did it, like the charwoman, to oblige. All such people of necessity are the worst and most incompetent. Speaking of the mechanical servants of a power station, our author says very truly that the wonderfully skilful engineer who saves his salary in a year is not in nearly such a position of opportunity as the fireman to make a loss or gain for his employers. It is in the boiler room and between the coal pile and the stop valve that money is lost. This is so essentially true that the wonder is firemen are often so badly paid. We hear it said that any fool can throw coal on a fire. So he can, but he cannot throw it in the right place, he cannot throw it at the right time, nor in the right quantity, nor, to quote a North country expression, can he throw it right side up, and the result is he may easily throw 20 per cent. of it to waste. Bad stoking is more especially bad when it has the least time in which to exert itself. Given a boiler that has to work 12 hours and stoking to some extent become self corrective, but on a short run the bad fireman may pile into a furnace an enormous amount of unnecessary fuel and may so continue to over load the furnace throughout the run, and when the end comes there is a lot of half-burned fuel thrown on to the dust heap. Such a fireman as this must not be confounded with the good man, who with a good draught, puts on gradually as much fire as the draught will work. The cases are quite different. In the latter case, after he has got this mass of fire, he keeps adding but little more fuel, and he regulates steam production by the damper, and as the end of the run approaches, he allows the fire to burn gradually out, so that at the finish the last spark of fire seems to die out just at stopping time, and the steam gauge suddenly drops back, the whole boiler becoming nearly dead. Where such possibilities of waste are present, the small changes that an engineer can make in a day are a mere cypher in comparison.

To use Mr. Carpenter's words, while the engineer may

adjust a valve once a week, in order to keep his machinery up to its maximum economy, the fireman makes an adjustment with every shovel of coal, and while an engine may be stopped or started with little loss, a boiler consumes fuel and labour every time it is started or stopped.

On the question of steam mains, the use of a number of moderate sized mains is preferable to one or two very large ones. Especially, we would say, does this apply to the valves which, when large, must have bye-passes to equalise the pressure on their two sides, so that they may even be moved. It is in large mains, if any, that breakdowns will occur and that duplication becomes, if at all, necessary. Within reason, therefore, small mains are preferable to large ones, and will assist to obviate the necessity of spare mains, the expense of which may well be better expended on improved gear that will not break down.

THE PREDETERMINATION OF THE REGULATION OF A TRANSFORMER WITH NON-INDUCTIVE LOAD.*

By FREDERICK BEDELL, Ph.D., R. E CHANDLER, M.M.E. and R. H. SHERWOOD, M.E.

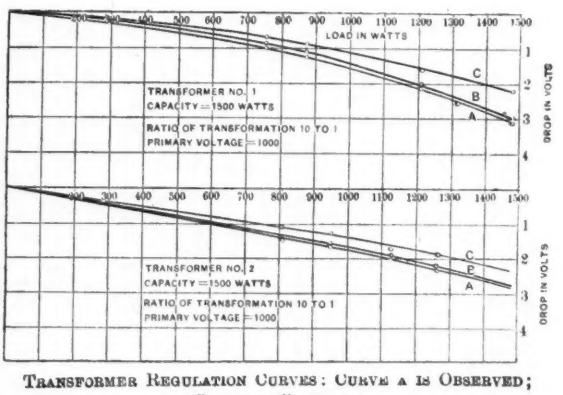
(*Concluded from page* 290)

If a wattmeter reading is taken when the magnetising current is measured, the iron losses are obtained, and the efficiency as well as the regulation determined. A transformer may thus be given a complete test for regulation and efficiency by making two measurements (without loading it), the source of supply being a lamp socket supplied from the house mains. The data for tests on the seven transformers are appended.

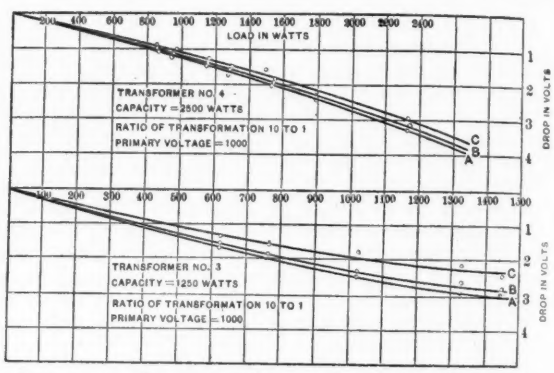
Log of Test No. 1.

Capacity of transformer, 1,500 watts.
Ratio of transformation, 10 to 1.
Primary pressure, 1,000 volts. Frequency, 126 ~.
Hysteresis loss = 55 watts.
Magnetising current = ·085 amperes.

Primary pressure.	Amperes in primary.	Watts.	Cos θ	Drop method C.	Drop method B.	Actual drop A.	Load in watts.	Efficiency.	K.
35	·755	7·2	·268	·7	1	·85	753	92·5	·0568
35	·76	7							
42	·887	10	·269	1·1	1·1	1·2	877	93·2	·0576
42	·885	10							
51	1·095	14·3	·262	1·34	..	..	1,010	93·6	·067
51	1·08	14·1							
61·5	1·32	21·6	·264	1·84	2·2	2·4	1,268	94·5	·0577
61·6	1·30	21·6							
64	1·36	23·0	·262	1·85	2·4	2·6	1,315	94·5	·0579
64	1·34	23·0							
69·2	1·5	27·5	·265	2·1	2·8	3	1,455	94·9	·0562
69·3	1·5	27·5							
70	1·52	28·25	·265	2·2	3	3·1	1,483	94·8	·0561
70·2	1·53	28·1							


LOAD IN WATTS
TRANSFORMER NO. 1
CAPACITY = 1500 WATTS
RATIO OF TRANSFORMATION 10 TO 1
PRIMARY VOLTAGE = 1000
TRANSFORMER NO. 2
CAPACITY = 1500 WATTS
RATIO OF TRANSFORMATION 10 TO 1
PRIMARY VOLTAGE = 1000
DROP IN VOLTS

Transformer Regulation Curves: Curve A is Observed; Curve B, Computed.


LOAD IN WATTS
TRANSFORMER NO. 4
CAPACITY = 2500 WATTS
RATIO OF TRANSFORMATION 10 TO 1
PRIMARY VOLTAGE = 1000
TRANSFORMER NO. 3
CAPACITY = 1250 WATTS
RATIO OF TRANSFORMATION 10 TO 1
PRIMARY VOLTAGE = 1000
DROP IN VOLTS

Transformer Regulation Curves: Curve A is Observed; Curve B, computed.

Log of Test No. 2.

Capacity of transformer, 1,500 watts.
Ratio of transformation, 10 to 1.
Primary pressure, 1,000 volts. Frequency = 126 ~.
Hysteresis loss = 55 watts.
Magnetising current = ·085.

Primary pressure.	Amperes in primary.	Watts.	Cos θ	Drop method C.	Drop method B.	Actual drop A.	Load in watts.	Efficiency.	K.
35	·72	7·25	·288	·99	1·2	1·25	711	92	·059
35	·72	7·25							
40	·825	9·4	·285	1·18	1·4	1·5	812	92·6	·0589
40	·825	9·5							
46·2	·97	12·8	·285	1·3	1·6	1·7	954	93·4	·0577
46·1	·97	13							
55	1·15	18	·285	1·74	2	2	1,127	94·2	·0581
55	1·15	18							
61·2	1·3	22·7	·285	1·9	2·25	2·3	1,270	94·3	·0575
61·3	1·3	22·6							
76·2	1·61	34·5	·232	2·5	3	3	1,562	94·7	·0575
75·8	1·61	34·3							

Log of Test No. 3.

Capacity of transformer, 1,250 watts.
Ratio of transformation, 10 to 1.
Primary pressure, 1,000 volts. Frequency = 124 ~.
Hysteresis loss = 35 watts.
Magnetising current = ·042.

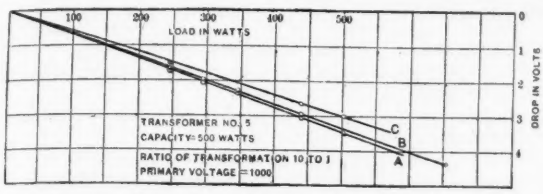
Primary presure.	Amperes in primary.	Watts.	Cos θ.	Drop method C.	Drop method B.	Actual drop A.	Load in watts.	Efficiency.	K.
15·3	·635	6·5	·667	1·35	1·5	1·6	625	93·8	·0227
15·3	·635	6·5							
19·7	·788	10·7	·675	1·59	1·85	2	778	94·5	·0233
19·5	7·88	10·5							
26·3	1·06	18·6	·670	1·8	2·3	2·45	1,033	95·2	·0230
26	1·06	18·5							
32·6	1·36	29·3	·663	2·1	2·6	2·9	1,321	95·4	·0226
32·6	1·36	29·4							
36·6	1·49	36·8	·667	2·4	2·8	3	1,455	95·5	·0231
36·8	1·5	36·8							
40·9	1·65	45·3	·670	2·7	2·9	3·15	1,598	95·2	·0233
41	1·65	45·3							

Log of Test No. 4.

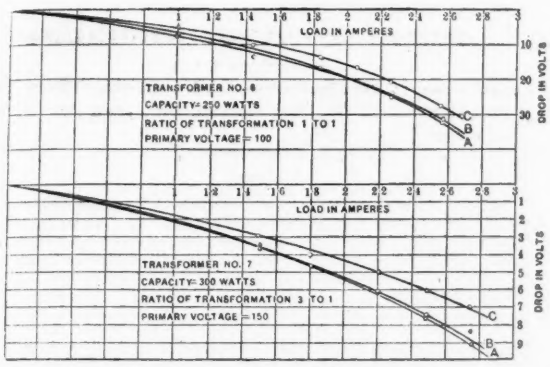
Capacity of transformer = 2,500 watts.
Ratio of transformation, 10 to 1.
Primary pressure, 1,000 volts. Frequency, 126 ~.
Hysteresis loss, 50 watts.
Magnetising current = ·058 amperes.

Primary pressure volts.	Amperes in primary.	Watts.	Cos θ.	Drop method C.	Drop method B.	Actual drop A.	Load in watts.	Efficiency.	K.
18	·85	8·25	·545	·99	1	1·1	832	93·5	·022
17·8	·845	8·25							
20·8	·96	10·9	·546	1·05	1·2	1·3	947·5	94·1	·0229
20·7	·96	10·8							
24·05	1·13	14·9	·550	1·30	1·4	1·5	1,128	94·5	·0224
24	1·13	14·95							
28	1·32	20·1	·553	1·59	1·65	1·75	1,297	94·8	·0224
28	1·32	20·4							
33	1·54	28	·550	1·65	1·9	2	1,510	95·2	·0226
32·9	1·54	28·2							
35·25	1·62	32·25	·563	1·92	2	2·1	1,585	95·2	·0228
35·25	1·62	32·15							
40·25	1·84	40·5	·550	2·2	2·35	2·4	1,795	95·5	·0229
40	1·84	40·5							
54	2·42	72	·554	3	3·2	3·25	2,343	95·4	·0226

* Presented at the Detroit meeting of the American Association for the Advancement of Science, August, 1897. We are indebted to the Authors for advance proofs.



Transformer Regulation Curves; Curve A is Observed; Curve B, Computed.



Transformer Regulation Curves; Curve A is Observed; Curve B. Computed.

Log of Test No. 5.

Capacity of transformers, 500 watts.
Ratio of transformation, 10 to 1. Frequency = 126 ~.
Primary pressure, 1,000. Hysteresis loss = 28 watts.
Magnetising current = ·037 amperes.

Primary pressure volts.	Amperes in primary.	Watts.	Cos θ.	Drop method C.	Drop method B.	Actual drop.	Load in watts.	Efficiency.	K.
17·3	·25	3·84	·923	1·6	1·7	1·8	245·5	88·5	·036
17	·25	3·8							
20·3	·30	5·67	·93	1·9	2	2·1	294	89·7	·0253
20·3	·30	5·67							
24·9	·345	8·35	·95	2·2	2·35	2·4	346·5	90·5	·0302
25	·355	8·37							
30·7	·452	12·73	·924	2·7	3	3·1	440	91·4	·0356
30·7	·451	12·78							
36	·52	17·65	·94	3	3·5	3·5	502	91·6	·0324
35·9	·52	17·64							

Log of Test No. 6.

Laboratory transformer No. 1. Capacity = 250 watts.
Ratio of transformation, 1 to 1. Frequency, 126 ~.
Primary pressure, 100 volts. Magnetising current, ·381 amperes.

Primary pressure.	Amperes in primary.	Watts.	Cos θ.	Drop method C.	Drop method B.	Actual drop A.	K.
21	1	3·01	·143	5	9	8	·0263
21	1	2·99					
32	1·44	5·5	·145	10	14	12·5	·0314
31	1·46	6·5					
41·5	1·86	11	·143	14	18	18	·0284
41·8	1·86	11					
46	2·06	14	·146	17	21·75	21·5	·0279
46·5	2·06	14					
51	2·25	16·7	·145	21	24·5	25	·0284
51	2·24	16·8					
57	2·55	21	·143	27·5	32·5	32	
57	2·54	20·8					

Log of Test No. 7.

Laboratory transformer No. 2. Capacity = 300 watts.
Ratio of transformation, 3 to 1. Frequency = 124 ~.
Primary pressure, 150 volts. Magnetising current, ·184.

Primary pressure.	Amperes in primary.	Watts.	Cos θ.	Drop method C.	Drop method B.	Actual drop A.	K.
12	1·48	3·83	·216	3	3·7	3·6	·01103
12	1·5	3·83	·213				
15	1·81	5·83	·215	4·1	4·5	4·7	·01025
15·2	1·80	5·83	·216				
18·3	2·2	8·67	·212	5	6·5	6·4	·01031
18·3	2·18	8·67	·212				
20·6	2·48	11·	·215	6·2	7·5	7·75	·01025
20·8	2·46	11·2	·214				
23·3	2·74	13·93	·218	7	8·4	9·2	·0105
23·3	2·72	13·82	·216				

Appendix.

The above method may be rigorously established by employing the transformer diagram, as given in Bedell's "The Principles of the Transformer."

In fig. 4 let O F be the direction of the primary current in a transformer, and O M the direction and magnitude of the impressed elec-

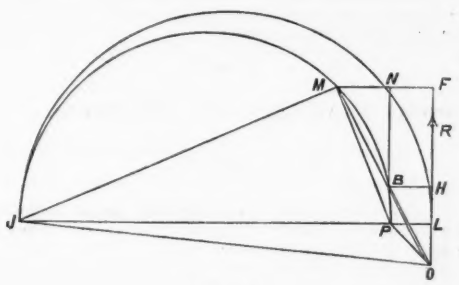


Fig. 4.

tromotive force necessary to send the current, O B, through the primary coils. As the resistance of the secondary is varied, the electromotive force which would be necessary to maintain this primary current constant would vary along the semicircle, J T H, being O J on open circuit, and approaching the point, L, when the secondary is short-circuited. If, however, magnetic leakage be present, the locus of the primary electromotive force necessary to maintain a certain primary current will be the semicircle, J M P. Let O M represent the normal primary electromotive force, and O B the normal primary current. O P would be the electromotive force necessary to send the current, O B, through the transformer, assuming that the secondary is short-circuited, and that its resistance is zero. This line will then be the impedance drop caused by magnetic leakage and primary resistance. Then it is evident that P M is the induced secondary electromotive force transferred to the primary,* since when added in its correct vector position to the drop, P O, it gives the primary electromotive force, O M. In order to obtain the electromotive force at the terminals of the secondary it is now only necessary to subtract the drop due to the resistance of the secondary coil. This is to be done algebraically, since the secondary current and electromotive force are in phase for a non-inductive load. If, therefore, a diagram as shown in fig. 4 can be constructed, and the length, P M, measured, it is only necessary to subtract from this the ohmic drop in the secondary, and divide by the ratio of transformation, to obtain the electromotive force at the secondary terminals.

In order to construct this diagram, proceed as follows:—The secondary is short-circuited, and the voltage necessary to drive the current, O B, through the coils, together with the angle of lag, is measured. This data enables the electromotive force triangle, B O H, to be constructed. In this triangle the line, O H, is the ohmic drop due to both primary and secondary, and may be represented by R I, where R is the combined resistance of the primary and secondary transferred to the primary; I is the current in the primary coil. B H will be the reactive drop caused by magnetic leakage, and may be represented by $k\,\omega$ I, where $\omega = \pi$ times the frequency, and k equals the self-induction due to leakage. O B is the impedance drop. It will be seen that the sides of the triangle vary directly with the load, and hence the angle θ is constant for any transformer for given frequency. This will be noted in the tabular data.

In most commercial transformers the ohmic drop is equally divided between the primary and secondary coils. Therefore by bisecting the line O H, and making P L = B H, the triangle, P O L, is obtained. Theoretically, P L is not quite equal to B H, but the semicircle, J M P, is so large, that the error is inappreciable. O J would be the electromotive force necessary to drive the current, O B, through the transformer when the secondary is on open circuit. This line is purely theoretical, and may be obtained from the simple proportion:

$$O\,J : E_1 :: I_1 : I_0;$$

whence

$$O\,J = \frac{E_1\,I_1}{I_0}.$$

Here E_1 is the normal primary voltage, I_1 the normal current, and I_0 the normal magnetising current. In other words, if a magnetising current, I_0, is produced by an electromotive force, E_1, a magnetising current, I_1, would be produced by O J. Sufficient data is now available for the construction of the complete diagram. Since the line O J is very large, compared with the other lines of the diagram, a large scale would be necessary for accurate work. The necessity of constructing the large semicircles may be avoided as follows: From the measurements made, B H or N F may be determined, as already explained. If M N can be calculated the point M becomes fixed, and the essential parts of the diagram may then be constructed.

* That is, the secondary electromotive force multiplied by the atio of transformation.

The triangles P N M and J M P are similar; hence we have

$$J P : M P :: M P : M N.$$

Therefore, $$M N = \frac{M P^2}{J P}.$$

Now, J P may for this purpose be taken equal to J O, since they are both very large as compared with P L or L O, and M P may be assumed equal to the primary voltage. It has been proven by trial that this latter approximation does not affect the result. On substitution of these values the equation becomes

$$M N = \frac{E_1^2}{J O}.$$

Substituting the value previously obtained for J O,

$$M N = \frac{E^2}{\frac{I_1 E_1}{I_0}} = E_1 \frac{I_0}{I_1}.$$

The line M N is the drop due to self and mutual induction. This added to the drop caused by leakage (B H = $k \omega$ I) forms the total reactive drop of the transformer M F.

The point M having been fixed, M O is drawn equal to the primary voltage, and the point O therefore determined. The rest of the diagram is constructed as previously described, and the secondary electromotive force determined.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

18,887. "Improved means for the production of gases for explosive purposes and propelling motor cars, cycles and other vehicles and discharging ammunition by electricity." T. R. W. Parnell and E. Bailey. Dated August 16th.

18,905. "Electric warning apparatus for mine cages." A. Florentine. Dated August 16th.

18,926. "Improvements in apparatus for interrupting or starting an electrical discharge for the production of ozone and other purposes." M. Otto. Dated August 16th.

18,934. "Improvements in automatic electric alarms." P. V. Vandevelde. Dated August 16th. (*Complete.*)

18,941. "Improvements in and relating to electric alarm and registering or controlling apparatus." C. Junge. (Max Vester, Germany.) Dated August 16th. (*Complete.*)

18,957. "Method designed to facilitate the coupling of wires for conveying an electrical current on railway trains." G. R. Powell. Dated August 17th.

18,994. "Improvements in the superheating of steam by means of electricity." J. H. Dunn. Dated August 17th.

19,017. "An improved method of an apparatus for advertising by electric light." J. G. Dixon. Dated August 17th.

19,035. "Improvements in electrolytic apparatus." H. Septon-Jones. (E. Balbach, jun., United States.) Dated August 17th. (*Complete.*)

19,037. "Improvements in anodes and vats for use in the electro-deposition of nickel." J. S. Morrison. Dated August 17th.

19,057. "Improvements in or relating to brakes for electric cranes." W. H. Vaughan and T. Foster. Dated August 18th.

19,066. "An improved mechanical electric apparatus for producing currents for intermittent use." M. H. Goldstone, J. H. Ward, H O. Farrell and J. Moores. Dated August 18th.

19,118. "Improvements in dynamo electric driving apparatus especially suitable for propelling vehicles." P. L. Goldschmidt. Dated August 18th. (*Complete.*)

19,123. "Improvements in electric tramways or railways." J. G. W. Aldridge. Dated August 18th.

19,179. "Process of manufacturing white lead by electrolysis." H. C. Wolterbeck. Dated August 19th. (*Complete.*)

19,180. "Improvements in and relating to electric heating coils." H. Hacking. Dated August 19th.

19,194. "A self acting double wheel running in one axle by a principle and power of magnetism." R. S. Kaufmann. Dated August 19th.

19,229. "Improvements in electric railway systems." L. E. Walkins and F. W. Dickinson. Dated August 19th.

19,230. "Improvements in a system for the electrical protection of safes." I. Freed. Dated August 19th. (*Complete.*)

19,289. "Improvements in incandescent electric lamps, &c. J. Sheehan and G. T. Hutchison. Dated August 20th.

19,307. "Improvements in or connected with electric arc lamps." F. S. Worsley. Dated August 20th.

19,334. "A new or improved wireless telephone." R. Johnson. Dated August 21st.

19,380. "Improvements in or connected with conduits for electric or cable tramways or railways." W. Griffiths. Dated August 21st. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d. (in stamps).*]

1896.

3,071. "Improvements in and relating to dynamo-electric generator and motor collecting brushes." G. E. Dorman. Dated February 11th, 1896. The collecting brushes are made of two or more carbons or equivalent means of increasing width and resistance by this means contact with each segment of the revolving commutator is very gradually broken whatever the direction of revolution the brushes being preferably fed radially but not necessarily so. 3 claims.

5,041. "Improvements in conductors for telegraphs, telephones, and electrical distribution." J. Swinburne. Dated March 6th, 1896. Electric mains, leads, and conductors are constructed of zinc, preferably zinc prepared by Ashcroft's process. 1 claim.

9,960. "Improvements in electric bell communications." F. Helmann and J. Carroll. Dated May 11th, 1896. Relates to an electric bell communication from dining tables, desks, or any similar piece of movable piece of furniture. In one case the bell push is suspended from the ceiling and in another case the wires pass through the legs of the table to connections at the bottom of the leg the floor is provided with a suitable contact piece. 13 claims.

12,149. "Improvements in electrolytic apparatus." T. J. Holland. Dated June 3rd, 1896. Relates to tanks wherein solutions to be electrolytically decomposed are contained, the object of the invention being to improve and simplify the construction of the tanks and to reduce resistance and economise working. The improved tank consists of a shallow open tank of glass and inverted removable boxes of earthenware supported in the glass tanks, and constituting air-tight cells, while their sides act as partitions for separating the electrodes. 2 claims.

12,244. "New or improved electrical lighting apparatus." E. Oldenbourg. Dated June 4th, 1896. The invention relates to electric cigar lighters. An inflammable torch is mounted so that it may be brought into electrical contact when desired, and in so doing complete an electrical circuit, thus causing sparks to pass which causes the spirit torch to become ignited. To extinguish the torch it is returned to its normal position by means of a spring to bear against a suitable valve surface. 3 claims.

21,930. "An improvement or improvements in the method of ensuring a quick break in electrical switches, known as the 'knife' switch, 'chopper' switch, or 'hatchet' switch." G. H. Verity. Dated October 3rd, 1896. Relates to improvements in 'knife' switches with a view to prevent the setting up of an electrical arc and consequent fusing of the contacts. The contact maker of the switch is carried closely parallel to the handle bar by means of a spindle in connection with a spring in the handle bar. By so arranging the parts in breaking circuit the brush does not commence to leave the contacts, until the handle bar is already some distance from the contacts, when the spring, which is now in compression, comes into action and completes the breaking of the circuit instantaneously and independently of the action of the hand. 3 claims.

29,040. "Improvements in means for automatically holding taut the communicating or conducting cord or chain of electrically driven vehicles." J. Entwisle (Luigi Della Beffa). Dated December 18th, 1896. The object of the invention is to obviate danger to persons entering and leaving the vehicle and to prevent them from being caught or interfered with by the cord, which, as a rule, is allowed to hang loose, and so as to provide for the oscillations and divergencies of the vehicle. A resilient spool is provided, the tendency of which is to keep automatically taut the wound on cord, the resilient construction of the spool allowing the cord to be unwound in obedience to any ordinary strain thereon, but automatically winding on again when the abnormal strain has ceased. 1 claim.

ELECTRICAL PATENTS OF 1883 EXPIRING IN SEPTEMBER, 1897.

We are informed by Messrs. W. P. Thompson & Co., that about 66 applications for electrical patents were filed in the month of September, 1883. Out of these applications some were never completed, and those that were not one has been maintained to run its full length of term, viz., 14 years, but were abandoned after the lapse of a few years.